THE

ELECTRICAL REVIEW.

VOL. XXXVII. OCTOBER 18, 1895. No. 934.

CONTENTS:

	PAGE
Death by the Electric Shock	469
Tunbridge Wells Electric Lighting Station (*illustrated*) ...	471
Phasing Transformers (*illustrated*) (*concluded*)	474
Electric Railway Management	476
The Hookham Electricity Meters (*illustrated*)	476
How to Test a Turbine (*illustrated*)	478
Opening of the Bristol Electric Tramways (*illustrated*)... ...	479
Correspondence:—Electric Lighting in Spain	481
The Paralleling of Compound Dynamos	481
Professional Etiquette	481
Information Wanted	482
The Choice of Transformers	482
Block Signalling...	482
Improved Motor Transformer (*illustrated*)	483
Business Notices, &c.	483
Electric Lighting Notes	484
Electric Traction and Motive Power Notes	486
Telegraph and Telephone Notes	486
Contracts Open and Closed	487
Notes	488
City Notes	490
Traffic Receipts	490
Share List of Electrical Companies	491
Alternate Current Motors (*illustrated*) (*continued*)	492
Lamp Making in England (*illustrated*)	494
The Institute's Next President	495
The Respirability of Air in which a Candle-flame has Burnt until it is Extinguished	495
New Patents	495
Abstracts of Published Specifications	496

THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

PRICE 4/- POST FREE.
The Leading Electrical Trades Directory and the Oldest Electrical Directory in the World.

1895 ISSUE READY.

PRICE 4/- POST FREE.
Fully Revised and Thoroughly Reliable.
Contains a larger amount of Trade Matter than any other Electrical Directory.

H. ALABASTER, GATEHOUSE & CO.,

22, Paternoster Row, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY

OFFICE:—22, PATERNOSTER ROW, LONDON.

Telegraphic Address: "AGENCY, LONDON." Code A B C. Telephone No. 517.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades

SUBSCRIPTION RATES.—In *Great Britain*, Post Free per Year, 19s. 6d. To *all other Countries*, per Year, £1 4s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.

FOREIGN AGENTS.—*New York*: D. VAN NOSTRAND, 23, Murray Street. *Paris*: VEUVE J. BOYVEAU, 22, Rue de la Banque. *Berlin*: ASHER & Co., 5, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London) to be made payable to M. H. ALABASTER, 22, Paternoster Row, E.C.

DEATH BY THE ELECTRIC SHOCK.

WHY do physicians rage and imagine vain things? Ignorance of electrics appears to be by no means uncommon in the medical profession, if we are to judge by the correspondence which has recently been going on in the *Lancet* on The Physiology of Death by Electric Shock. The discussion in the *Lancet* was started by a report on some investigations by Dr. A. M. Bleile, of Ohio, on the bodies of animals killed by the electric shock. Dr. Bleile experimented with strong currents on dogs, and his paper on the subject will be found in our issue of July 26th. On examining the heart immediately after death, the left side was found to be completely relaxed, and the right side, with the large veins near it, completely gorged with blood. The arteries were contracted down to a very small calibre. Dr. Bleile's conclusion was, "that death in electric shock is really due to the fact that the current produces a contraction of the arteries through an influence on the nervous system, and that this constriction of the arteries throws in such a mechanical impediment to the flow of the blood as the heart is unable to overcome." This view was confirmed by administering nitrate of amyl, which is known to have the effect of distending the arteries. It was found that animals to whom this substance had been administered could stand a larger shock without fatal results.

Dr. Bleile's theory that the effects of the current on the animal body are physiological, appears reasonable enough, when we consider the power that even very small currents have of producing violent muscular contractions. But the *Lancet* correspondents, Drs. Shettle and McClure, are not content with this simple explanation, but will ascribe the effects to the physical and mechanical effects of the current on the component substances of the body. Here it is that they get beyond their depth. Dr. Shettle says: "The contraction of the arteries is unquestionably due to a physical cause acting primarily upon the contents of the vessels—*i.e.*, the blood—and secondarily through the blood upon the nerve and muscular fibres which enter into the composition of their structures. This physical cause is the passage of the electric current, and its effect is first produced in the arteries for the following reason: the arteries and veins are both filled with blood, but the *magnetic charge* in the arterial blood is greater than in the venous blood. This difference in the amount of magnetic charge is due to the oxygen which has been absorbed during the circulation of the blood through the lungs, and is in proportion to the oxyhæmoglobin which has been formed thereby." It is difficult to understand what is meant by the magnetic charge being greater in the arterial than in the venous blood, till we refer to some experiments (*Proceedings* Royal Society, 1875) made by Dr. Shettle, in which he shows that venous blood suspended in a medium of arterial

blood is diamagnetic, and *vice versa*. These experiments are very interesting, and appear to have been carefully carried out, but that is no reason why they should be dragged in to explain something with which they have no connection. Because oxygen has been shown to be feebly magnetic in strong magnetic fields, Dr. Shettle imagines the atoms of oxygen in the arterial circulation behave like a procession of natural magnets, and induce electric currents in the surrounding tissues, which play important parts in the vital processes. Even the earth's magnetic field is requisitioned to produce in some mysterious way these electric currents. To show that this is no travesty it will be sufficient to quote one or two sentences from Dr. Shettle's letter. "The nature, therefore, of the blood corpuscles, on the flow of which the energy of every living animal depends, is determined in this respect partly by the magnetic force of the oxyhæmoglobin, and partly by the rapidity with which they traverse any given space, and strike the lines of the earth's magnetic force; and the character and amount of the current energy originated in any living animal by the motion of its blood depends on the nature of the blood corpuscles, and also upon the number of the corpuscles which are passing at any given moment over a nerve or other conductor of the impression." The letter is full of this sort of incomprehensible jumble. The experiments of Tyndall have shown that the most powerful magnetic field has no perceptible effect on the human body, and therefore to construct a theory in which the infinitesmal fields produced by the earth or by oxygen play important parts in vital processes, is absurd.

Dr. McClure, though he cannot be charged with the irrelevance and unintelligibility of the other correspondent, demonstrates in his letter the proverbial danger of a little learning. Dr. McClure considers that the contraction of the arteries is unquestionably due to a physical cause. "Faraday taught us long ago that the seat of the phenomena was not in the conductors, but in the insulating medium surrounding them. The electrical energy does not travel by the wire, but by the insulating sheath or dielectric surrounding it." From this "modern view" Dr. McClure deduces that though the blood is the best conductor in the human body, the insulating tissues transmit all the energy. "There is tension along the lines on which electricity is travelling, and pressure at right angles to this. This is just the force that would narrow the calibre of the artery." Dr. McClure, instead of basing his conclusions on the known effects of an electric discharge through a dielectric, deduces them from a far-fetched hypothesis of the electric current, which is probably at the present day accepted by few, if any, physicists of eminence. The properties of lines of force, by which he seeks to explain the contraction of the arteries, apply to the static field, and not to the kinetic field, which is here in question. Moreover, in electric shocks, we are dealing with rapidly varying currents which have many peculiarities that will have to be taken account of, in any attempt to picture what goes on inside the subject operated upon.

In cases of death by the electric shock, the oxyhæmoglobin in the arteries is found to have been almost completely reduced. As the blood is a good conductor, a large proportion of the current must pass through it. The arterial blood contains oxygen loosely combined with the hæmoglobin, and this evidently is set free by a kind of disruptive or electrolytic action of the current.

We do not pretend to be able to deal with the physiological aspect of this question, though we have little doubt that in the action of the electric discharge on the nerves and muscles, the true explanation of the condition of the heart and arteries is to be found. The physical explanations offered by the two correspondents of the *Lancet*, we have no hesitation in saying, are opposed to the known facts of electrical science.

When such hazy and inaccurate ideas on electrical questions are to be found even among professional medical men, is it surprising that the non-professional public should be so easily taken in by the electro-medical quack?

Relative Cost of Different Illuminants.

Wedding (*Electro Zeit*, Vol. 16, p. 556), estimates the cost of a 16 candle light produced by different sources of light, and finds that the gas incandescent light, and the electric arc light, are the cheapest, while the acetylene light is the dearest. He arranges the following lights in the order of their cost per 16 candle light, as follows: Arc light and gas incandescent light, petroleum lamp, Argand gas burner, electric incandescent light, acetylene. He considers that the arc light, though about equal in cost to the incandescent gas light, possesses great advantages over the latter especially for the lighting of streets, large open places, and large halls. The distribution of the light from the arc is better suited for giving a uniform illumination, than is the case with the gas incandescent light. He points out that lights of thousands of candles can be produced by the electric arc, while 100 to 200 is the highest that has been attained by the gas. Besides, in recent years, small arc lamps have been made and work satisfactorily, giving an average light of 40 candles with a current of 1 ampère and a consumption of 40 watts; and though in these small arc lamps the efficiency is less than with larger arc lights, they can be used without translucent globes, and thereby avoid a considerable loss of light. The arc has also a great advantage over the gas incandescent light in the colour of its light, in which, though there is a slight excess of violet light, all the other colours of the solar spectrum are well represented. Wedding concludes, after careful comparison of all known sources of light, that the electric arc light is undoubtedly the best for lighting large areas.

Instances of Professional Etiquette.

A correspondent, whose letter appears in our Correspondence columns, gives his experience of the consulting electrical engineer who plies for hire. We have it on the authority of distinguished agriculturists that the ancient Statutes or Hirings are fast dying out, but out of consideration to the number of electrical engineers who are anxious to be consulted, we think they might be revived with much advantage. Then, on the day set forth for the "Hirings," the young "consultants" might be gathered together, electric lighting committees, and those who desired the luxury of consulting, would then be able to study their physique, and put them generally through their paces. Though one is very much inclined to make merry over the littleness of some members of our profession, it is a most lamentable feature of electrical engineering. Our correspondent's remarks clearly show what a member of another profession thinks of the undignified attitude gratuitously adopted by some consulting engineers. Unfortunately, there is no cohesion and little definition in the electrical profession. There is nothing in an electrical training any more than in another to inculcate in a man too keen a regard for sordid pelf; we are afraid the trouble lies in over-production. The scramble which is taking place among the younger members of the profession is a spectacle that is viewed with regret by all reasonable men.

TUNBRIDGE WELLS ELECTRIC LIGHTING STATION.

As we briefly notified in last week's issue, the electric lighting station of Tunbridge Wells was opened on Wednesday, the 9th inst., by Sir David Salomons (the Mayor) and Lady Salomons. Several local speakers stated that Tunbridge Wells had the reputation of being the sleepiest town in the Kingdom, and we are quite prepared to believe the claim to be valid, for the proceedings which were advertised to commence at 1 p.m. were just upon an hour late; the lack of organising power was painfully apparent, and the circus procession which followed the opening of the station turned, what should have been, a dignified function, into a laughable and ridiculous spectacle.

Of this "very imposing pageant," imposing in more ways than one, the less said the better, and we can only think that the programme, which a contemporary published in full as an example of Sir David's "untiring efforts," must have been arranged without his cognizance.

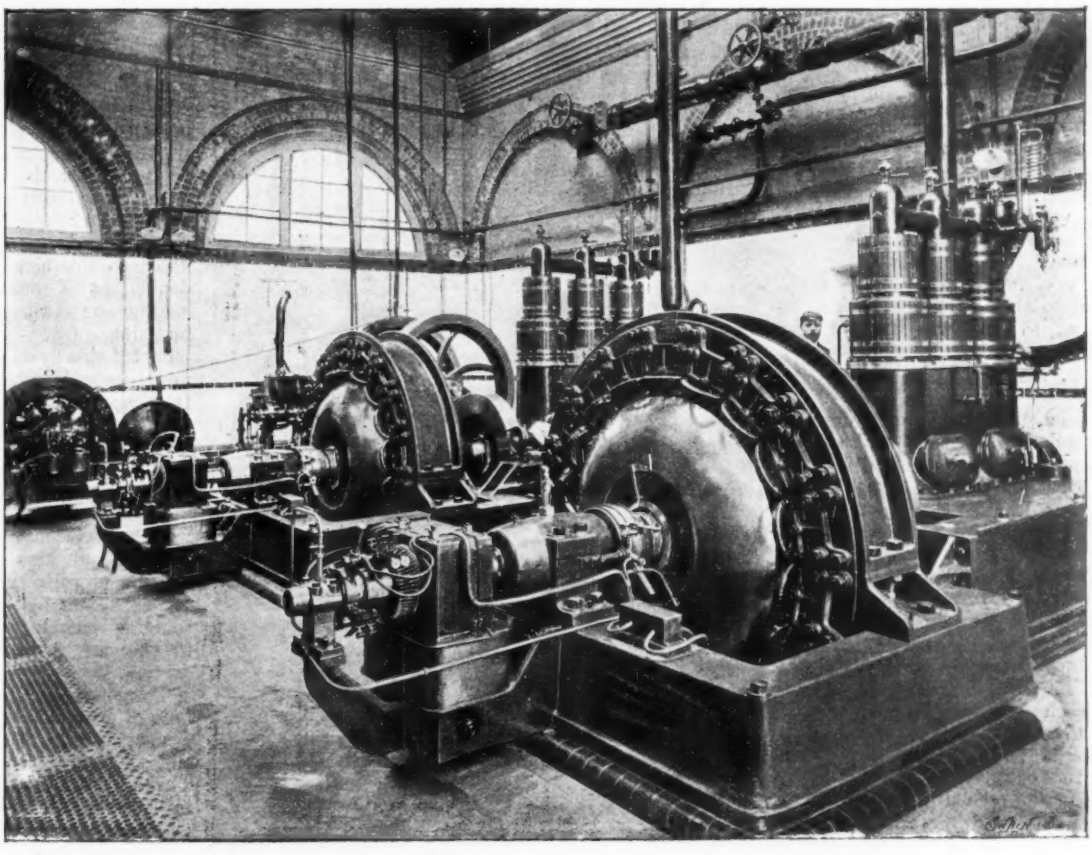
In August, 1892, Mr. W. H. Preece was called in by the Corporation, and in his report he succeeded in bringing home to the minds of that authority the advantages possessed by working the installation as a municipal undertaking. There has been borrowed for carrying out the work two sums amounting together to £37,000. The alternating current system was recommended as the more suitable.

The borough electrical engineer in charge of the undertaking, Mr. H. L. P. Boot, who was appointed a few months ago, is at present engaged in connecting consumer's premises to the mains, and we learn there are already about 4,000 lamps thus connected, the charge per Board of Trade unit being 6d.

The site, selected upon Mr. Preece's recommendation, is in close proximity to the South Eastern Railway Company's goods station, and expense in conveying coal is thus obviated. Mr. A. Ardon, F.R.I.B.A., designed the buildings, which luckily have been erected in a manner which will allow of extensions being easily effected. The following is a list of the contractors who have had to do with the work:—

Messrs. Johnson & Phillips, alternators and exciters.
Willans & Robinson, Limited, engines, &c.
S. Z. de Ferranti, Limited, rectifiers.
Crompton & Co., Limited, transformers, switchboard, voltmeters, &c.
Babcock & Wilcox, Limited, boilers, feed pumps, &c.
W. Macfarlane & Co., lamp posts.
Callender Bitumen Telegraph and Waterproof Company, mains and cables.

The boiler house contains two boilers, which have been installed by Messrs. Babcock & Wilcox, whose manufactures have done more towards making electric lighting a practical thing than has generally been recognised. They have each 1,426 square feet of heating surface, and are set together in one battery. Each boiler is composed of eight sections, the sections being made of nine tubes, 4 inches diameter and 16 feet long. The steam and water drum of each boiler is 42 inches in diameter, and is fitted with two dead-weight confined flow safety valves, and one steam isolating valve with drain.



View of Alternators.

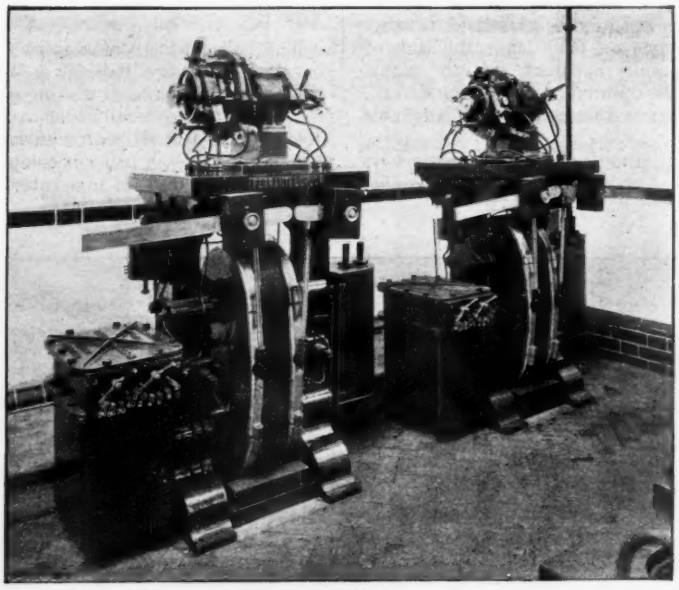
The boilers after erection were tested hydraulically to a pressure of 250 lbs. per square inch, the ordinary working pressure being 150 lbs. Welsh coal is employed as fuel, and the air space between the fire bars is $\frac{3}{8}$ths inch.

The boilers were constructed under the inspection of the National Boiler Insurance Company, of Manchester, and are fitted with Probert & Bridge's low water alarm, and tester taps for pressure gauge. The firm, in addition, supplied the whole of the feed piping, suction piping, feed, and exhaust piping to the pumps and economiser, together with two feed pumps, with sight feed lubricators and pressure gauge, one tank pump, with sight-feed lubricator, for raising water from their well to the overhead storage tank, one cast-iron tank for water storage, holding about 5,000 gallons, the chequer plating, &c., as well as the Green's economiser, which con-

sists of 128 tubes, and is complete with driving engine and necessary shafting.

Messrs. Babcock & Wilcox also carried out the brickwork setting of the boilers, and the flue work above the floor level. The fronts of the boilers are finished with glazed bricks, and the tops of the walls are paved with stone flags.

In the engine room there are two of Willans & Robinson's GGG-S size compound, running at 450 revs. per minute. Each engine has three cranks at 120°. The low pressure cylinders are 14 inches in diameter, and the high pressure 10 inches. The stroke is 6 inches. These engines are to do 110 to 115 brake H.P., but they are capable of doing about 135 B.H.P. at the maximum power. The steam pressure is 150 lbs. above the atmosphere in the boilers, and the engines are working non-condensing, but are to exhaust into a condenser later on we understand. Each engine is coupled direct to the alternator. As the day load will naturally be very small at first, a 15 nom. H.P. Stockport gas engine, connected to an alternator giving 15 kilowatts at 580 revolutions per minute, has been provided to take this light load, the steam plant being used in the evening only. In this department there is also an overhead travelling crane running the entire length of the room.



Ferranti Rectifiers.

The switchboard was supplied by Messrs. Crompton and Company, Limited.

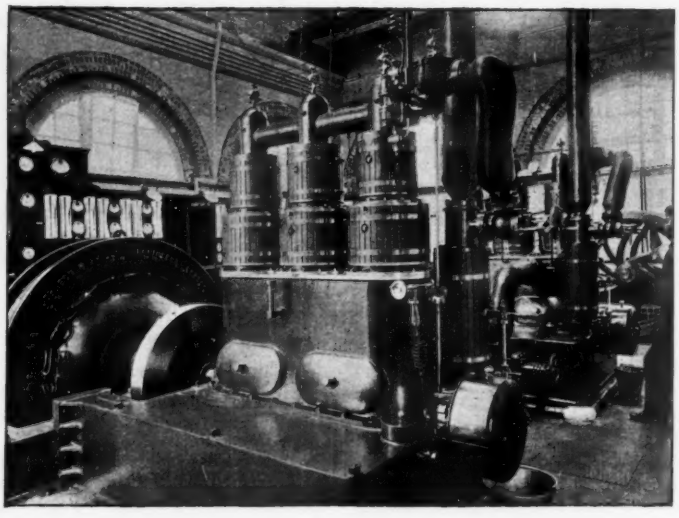
The Alternators.

There are two alternators supplied by Messrs. Johnson and Phillips, which have stationary armatures and revolving field magnets. They are each capable of giving continuously an output of 75 kilowatts at 2,100 volts, with a speed of 450 revolutions per minute, and work at a frequency of 68 complete cycles per second. The armature coils are each embedded in a core sector, constructed of the best annealed charcoal iron, properly laminated, and built up on insulated steel through bolts; they are properly secured to a strong cast-iron circular shell, resting on and fastened to the bed of, the machine, the whole forming a cylinder, inside of which the field magnet rotates. Each armature coil is completely enveloped by specially prepared coverings of mica cloth, before being embedded in its sector, and is further separated therefrom by fibre sheet. Each sector is flashed between core and coil with an alternating difference of potential equal to at least twice the normal voltage before mounting in the containing shell. Each sector of the armature, with its coil, is capable of quick removal and replacement without disturbing in any way the adjacent sectors. The armature circuit terminates in two gun-metal blocks mounted on an ebonite plate, and is secured to a teak base mounted on the bed of the machine. These terminals are protected by a teak wood cover, so that nothing may accidentally touch them.

The base plate is of cast-iron of substantial design, with planed facings for the circular shell carrying the armature sectors, and planed faces for the plummer blocks. The underneath surface of the base plates also is planed.

The field magnet system consists of a star-shaped casting of special magnet steel, having its polar projections alternately N. and S., forming a cylindrical surface. It is turned true on the exterior, and perfectly balanced. The field is excited by a single coil of insulated wire wound on a cast-iron drum placed in the centre of the magnet, which is insulated in the best manner before winding. The exciting current is conveyed to this coil by a double set of brushes, resting on two contact rings of gun-metal mounted side by side on, and thoroughly insulated from, a substantial cast-iron bush, which in turn is keyed upon the shaft. The brush-holders are provided with suitable terminals to take the conductors carrying the exciting current.

The shaft is of the best Bessemer or Siemens steel of ample strength throughout, and is turned bright all over, with keyways machine-cut, and all keys and feathers properly fitted. It has a suitable half-coupling securely keyed to one end for direct driving.



View of Engines.

There are two bearings of best hard gun-metal, made in halves, and of ample length. They are properly bedded in substantial cast-iron plummer blocks, fitted with suitable caps and firmly secured to the machine base plate. Each bearing has a visible feed lubricator of ample size provided with the necessary adjustments, and the requisite oil save-alls and drain pipes are fixed. The machines are capable of working perfectly in parallel with others at any load and of working continuously without overheating in any part.

Feeders and Mains.

The distribution is on the high-tension system, the current being supplied from the generating station in Stanley Road to seven sub-stations through four high-pressure feeders and three sub-feeders.

A system of low-pressure mains are laid from the sub-

stations wherever the demand for current warrants the necessary outlay. There is also an arc light circuit laid throughout the main portion of the town.

The whole of the cables for the high-pressure feeders, low-pressure distributors and arc light mains have been manufactured and laid by the Callender's Bitumen Telegraph and Waterproof Company, Limited, whose engineer on the work was Mr. Hy. Schiasse.

The type of cables employed throughout the whole of Tunbridge Wells is concentric lead-sheathed and armoured, and have conductors of the following sectional area :—

Feeder A	... ...	·025 square inch.
„ B	... ...	·035 „
„ C	... ...	·035 „
„ D	... ...	·050 „
Sub-Feeder A 1	.. ...	·025 „
„ D 1	... ...	·025 „
„ D 2	... ...	·025 „
Arc main	... ...	·022 „
Distributors	... ...	·10 „
„	... ...	·15 „
„	... ...	·20 „

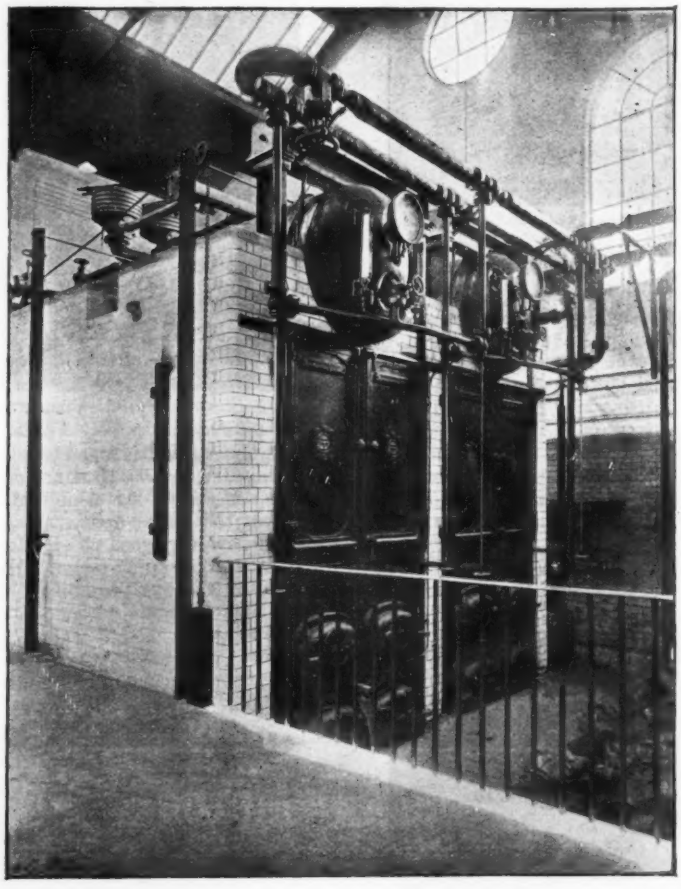
Feeder A, together with sub-feeder, A 1, is 1,817 yards in length, and runs from electric light station through sub-station No. 1 at the junction of Calverley Road and Mount Pleasant, and thence *viâ* Grosvenor Road to Mount Ephraim sub-station.

Feeder D runs from electric light station through sub-station No. 1, thence down Mount Ephraim Road to the junction of London Road, and is 1,350 yards in length.

Feeder B is 1,800 yards in length, and goes from electric light station to sub-station No. 3 in High Street.

Feeder C is 2,410 yards in length, and runs *viâ* High Street, looping into sub-station No. 3, and thence *viâ* the Pantiles to sub-station at the north end of same, opposite the pump room.

Sub-feeder D 2 is 1,170 yards in length and runs from the junction of Mount Ephraim Road and London Road (where D ends) *viâ* London Road to transformer chamber in Neville Street.



View of Boilers.

Sub-feeder D 1 is 860 yards in length and is also run from where D ends in Mount Ephraim Road along Mount Ephraim to Mount Ephraim House.

The total amount of cable supplied to Tunbridge Wells, together with their respective sizes, are :—

·025 square inch	... ...	6,874 yards.
·035 „	... ...	5,362 „
·050 „	... ...	1,350 „
·022 „	... ...	3,796 „
·10 „	... ...	2,781 „
·15 „	... ...	1,175 „
·20 „	... ...	85 „

House services are also laid on with concentric cable, lead-sheathed and armoured. These cables are of four sizes, viz., seven No. 16, seven No. 14, 19 No. 16, 19 No. 14, the services being joined to the mains in cast iron boxes, plan of which is shown, the house ends terminating in Reid's fuse boxes.

The whole of the street work has been executed by the Callender Company.

Ferranti Motor Commutators or Rectifiers.

The arc plant now running at Tunbridge Wells consists of two complete rectifier sets of a similar design though of smaller unit to those now running at Blackpool, Edinburgh, and Southport. Each set comprises synchronous motor, overhung single break commutator, constant current converter with its attendant water-break switch and dash-pot, and 2-unit converter for transforming down to run the motor.

The figure is a reproduction of the actual apparatus from a photograph. The motor is of the Brown synchronous type with six-pole field commuted by small two-part commutator. The motor is run up as an ordinary shunt with resistance in the field circuit. On attaining synchronism the resistance is cut out and the field excited from a few turns of the armature.

The commutator is overhung and is built on the motor spindle. It consists of two separate castings, each casting carrying three segments. The two halves are then mounted on conical ebonite bushes and the whole is securely locked on a steel sleeve, forming a mechanical structure of great rigidity and of great simplicity. Each segment has attached, but perfectly insulated from it, pieces of copper strip to shatter the arc. The number of segments on the commutator is dependent on the periodicity employed.

The constant current converter is of the vertical pattern, consisting of two sets of primary coils suspended from knife edges, and two sets of secondaries which are firmly fixed on the core. The magnetic circuit is of the closed type.

The force of repulsion between primary and secondary is balanced by weights acting on levers, which thereby form a convenient adjustment for setting the converter at exactly the current best suited to the circuit.

As the distance between primary and secondary increases, the induction in the secondary decreases, so that the lamps automatically regulate their pressure.

The converter can be so adjusted as not to allow a rise of more than ·06 ampere per lamp from full to half load.

The primaries are firmly held by split German silver bands.

Teak coil carriers support the knife edges. Knife edged seats are also used for suspending the coils from the cross bars.

Each rectifier is provided with quick break reversing switch, pole indicator and interchangeable plugs for switching either rectifier on to circuit.

The plant is extremely compact and takes up but little room in the station.

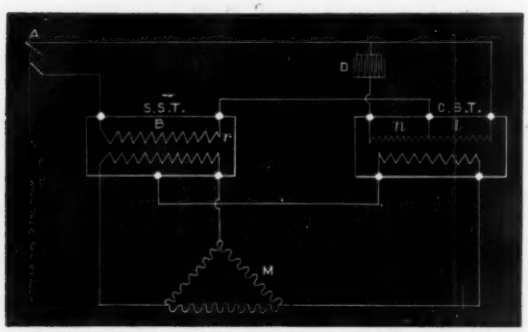
PHASING TRANSFORMERS.*

By CHARLES S. BRADLEY.

(*Continued from page* 468.)

Mr. Scott's invention for changing two phases to three may also be used, and is shown in fig. 6. Making the resultants in this manner by means of the secondary windings contributes also to steadiness of phasing. If desired, two secondaries having a proper two-phase relation may be used on the motor.

The experimental work, in which I have been greatly assisted by Messrs. Hulse and Chapman, has occupied a long time, and has passed through a great many stages. The results represent a great deal of patience, and we have chased the phases from zero to 180°, back and forth, until



S S T, Simple section of transformer; C S T, Compound section of transformer.

FIG. 6.

there is a well-worn path between these two points, but finally we have a set of beautiful results, and the electromotive force curves will be found in fig. 7, taken from the transformer, in connection with a ½ horse-power motor, running at full load, and fig. 8 gives the current curves of the same. This motor gives powerful starting torque, and it gives me pleasure to show it to you here in operation. I want to bring to your attention one feature of the compound coil used in combination with the condenser, which will be found in figs. 9 and 10. If we suppose a direction of motion as shown by the arrow, and the current in the condenser branch leads by 90°, which is represented at *b*, and the current in the inductance branch lags by 90° as indicated at *c*, and the wires carrying these currents are wound in opposite direc-

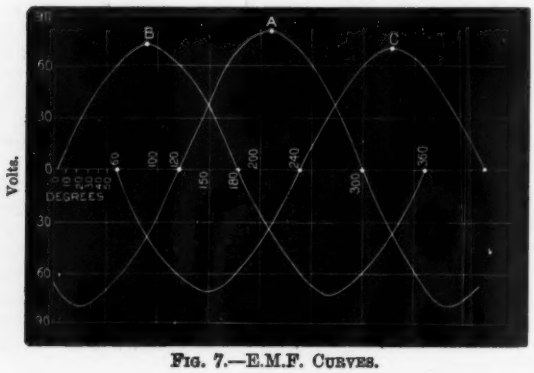


FIG. 7.—E.M.F. CURVES.

tions upon the core, we will have a resultant current, which is represented by extension, *d*. Increase of load changes the phase relation of the individual branches, but not the resultant secondary, and this is explained by reference to fig. 10, where a 75° lead, and a 75° lag, are represented by the respective branches, and as the branches are wound in opposite directions, we find that when *b* is turned over, it becomes a lag of 105°, and the resultant of 75° and 105° again produce 90° lag, and the value again represented by the extension, *d*, the value of the current is slightly less, but its resultant phase is the same as is represented in fig. 9. This explains the steadiness of phasing which we are able to obtain. This may be explained by another method of diagramming as is shown in figs. 11 and 12, where curve *a* represents the fundamental current, curve *b*, fig. 11, a lead of 90°, curve *c* a lag of 90°, and then *b* being turned over, unites with *c* to produce the resultant, *d*, which is 90° in lag of fundamental curve, *a*. Now, in referring to fig. 12, where the fundamental current is again represented by *a*, curve *b* represents a lead of 75°, and full line curve, *c*, represents a lag of 75°; then, when curve *b* is turned over in the windings, as shown in the dotted line, the coils being wound upon the same core, a resultant effect is represented by the curve, *d*, which is 90° in phase from fundamental curve, *a*. Thus we see by increase of load, which tends to decrease the lead of the condenser circuit, and also decreases the lag of inductance circuit, our resultant is still in the same phase relation to the fundamental current.

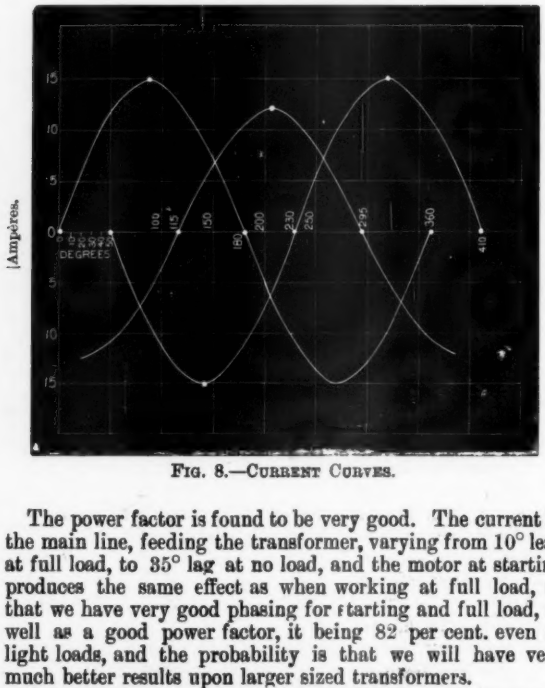


FIG. 8.—CURRENT CURVES.

The power factor is found to be very good. The current in the main line, feeding the transformer, varying from 10° lead at full load, to 35° lag at no load, and the motor at starting produces the same effect as when working at full load, so that we have very good phasing for starting and full load, as well as a good power factor, it being 82 per cent. even at light loads, and the probability is that we will have very much better results upon larger sized transformers.

The condenser in this combination fills two very important functions; first, assists in the phasing, and second, prevents the lag upon the line. This arrangement does not prevent

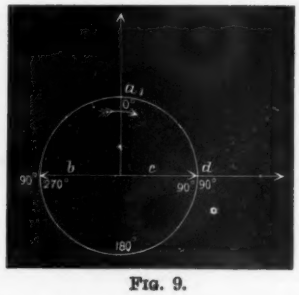


FIG. 9.

the idle currents flowing in the motor circuits, and the secondaries of the phasing transformer, and we find in small motors with the high period of 140 cycles that the apparent energy in the motor circuits is sometimes 2½ times the apparent energy in the main line. The capacity of condenser for a ½-horse-power motor when 1,000 volts are supplied to the transformer is about 2·4 microfarads. Our condenser for this size, without connections, occupies a space of a cube 4 inches on each side, and capable of enduring 3,000 volts, or a factor of safety of four, as the voltage on the condenser is about 700. Of course, it will be understood by those familiar with the designs of induction motors, that it is

* A paper presented at the 99th meeting of the American Institute of Electrical Engineers, New York and Chicago, September 1895. Subject to Revision.)

impossible to design a small motor with small power factor, as the air-gap necessary for mechanical construction has to be so large in proportion to the size of the motor.

Many attempts have been made by placing the condenser in direct connection with motors to produce rotary fields, but have so far been attended with little success, as the trade requires the motor to be of comparatively low voltage, which calls for a large capacity in the condenser, and as the output of the condenser of a given capacity is proportional to the square of the voltage, it will be seen how advantageous it is to place the condenser in combination with the primary of the step-down transformer.

It may seem trite to call your attention to the fact that the transformer reduces the voltage at the same time it does the phasing, but I think it is so important that I wish particularly to emphasise the fact. It is also of great importance that the device has no moving parts.

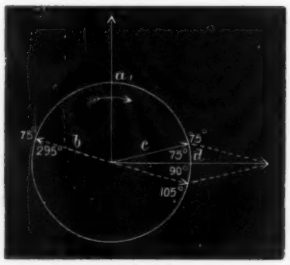


Fig. 10.

Upon reference to the cuts showing the curves obtained of the electromotive force and current, it will be readily seen that they are all of true sine form. The current for this work was obtained from a 75 kw. Slattery alternating machine. This machine has a surface winding on the armature, and therefore gives practically a sine wave. Just what the transformer may do on all the various dynamos that are in the market, giving all sorts of complex waves, it is difficult to say, with our present experience, but, so far we know now, the transformer tends to smooth out all the irregularities.

While the principal use for this device at present seems to be the application of polyphase motors to single-phase lighting systems, many new ones, undoubtedly, will be found. It may seem bold to think of applying this to long-distance trolley railroads, but I am hoping to have it done.

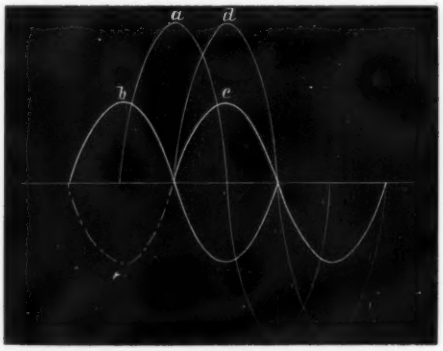


Fig. 11.

It is much more simple to have one trolley wire with track return, than to have two trolley wires which would be required by the direct application of polyphase systems. A large amount of power requires either a large current or high voltage, in order that the resistance of contact of whatever device is used to make connection to line need not be too great. As viewed at present, it seems as if the alternating current must be used for this work. If so, and unless the traffic is extremely frequent, it will take many more transformers, if they be placed along the line, than if the transformation is made upon the car or locomotive, because the transformers along the line, having no trains or cars near them, would be idle.

If the voltage is stepped down on the car or locomotive, it is just as economical to do it by the phasing transformer, with the exception of the added weight of condensers, which for a 1,200 H.P. locomotive will be about two tons, and this is not of consequence on so large a power.

These condensers are very compact and efficient, and will stand from three to four times their working voltage without puncturing the dielectric. I am sorry I cannot show you the condenser in all its details, but, for certain reasons, I cannot do so at present, but will present it to the Institute at the first opportunity.

A brief description of the motor may be in order, although it does not belong strictly to this subject. We met with much difficulty in developing a motor for so high a periodicity as 140 cycles. It is necessary to keep the density so low, and it is always such a temptation to try to get all the power from a given piece of apparatus, that they are always heating much more than they should.

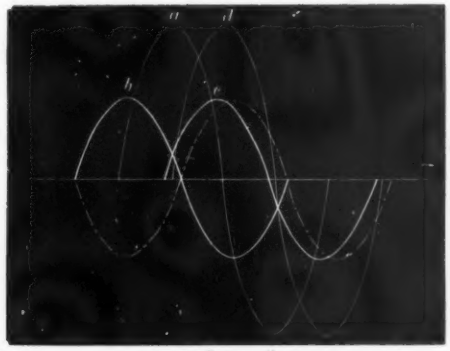


Fig. 12.

With a large number of poles and slots, we found that any use of wide bars in the armature was out of the question, for the eddying currents in the copper were too serious. *We also looked for difficulties which we never found.* At times we thought the heating was due to higher harmonics produced from the phasing transformer; but the fact is, we never found any, unless it was in the experiments upon the two-phase motor. As mentioned before, the waves are all of the true sine form.

Cuts of the motor are shown in figs. 13 and 14, the rotary field being the exterior or stationary part, and the secondary or induced constituting the armature. The armature is composed of two sections, or practically two armatures end to end upon the same shaft, one of the armatures having a low resistance winding and the other a comparatively high resistance; the field is placed over a high resistance for starting, and shifted by means of a lever over the low resistance, when it

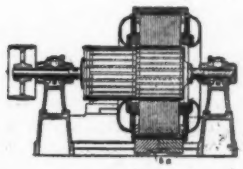


Fig. 13.

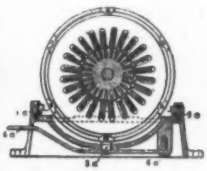


Fig. 14.

has nearly attained speed. Of course, this arrangement is for securing the starting up of the motor, and has nothing to do with the phasing transformer, and the motor might have rings for connecting the starting resistance to the armature, and operate quite as well. The sliding of the field gave trouble, as the air gap has to be small, and the play at the sides (noted 1*a* and 2*a*) allowed the armature to strike against the field, and when a tight fit was made, which would work easily when cold, it would stick fast when the motor rose in temperature; the writer, therefore, decided to give it quite a clearance at these points, and give it a guide at the bottom of the field shown at 3*a*. This being central, and comparatively thin, the expansion is not sufficient to cause sticking, also the guides at 1*a* and 2*a*, being thin vertically, they may fit close and still slide easily. The lever for moving crown back and forth is shown at 4*a* (fig. 14), and 5*a* (fig. 13). It fits loosely, having a fulcrum at 6*a*.

C

ELECTRIC RAILWAY MANAGEMENT.

In a paper read at the recent convention of the Pennsylvania Street Railway Association, at Wilkes Barre, Mr. A. K. Baylor states that direct connection of engines and generators has in most cases everything in its favour, and where land is high and rents large, these two points alone will dictate the choice of this type of unit. Experience has shown that the great fluctuation of load inevitable in railway work is a negligible factor with respect to serious strains on direct connected units where a properly proportioned fly-wheel is introduced between the engine and the armature. As to the proper division of units, generally speaking, perhaps the best plan is the installation of three units of equal size, two of which are capable of carrying the full load. This permits of economical running, both at half load and full load, and leaves one unit always in reserve. Some roads, however, have made a division of power into, say, two large units, equal to one-half the full load, and one small unit, equal to one-quarter of the load, thus practically permitting full load to be maintained all the time. The combinations of these machines will give one-quarter, one-half, three-quarters and full load, but in case one of the large units gives out, the remaining units will have to be considerably overloaded to handle the full load of the station.

The paper recommended, says the New York *Electrical World*, that buyers should confine their specifications to general considerations, leaving the details with the manufacturers; otherwise, by insisting on some peculiarity of detail, the machine delivered may be inferior to what it would have been had the manufacturer been allowed greater liberty with respect to design and then held accountable for results.

It is pointed out that, besides the saving in series parallel over rheostatic control, which amounts to from 25 per cent. to 40 per cent., the size of the generating plant with the former is less and the effect of momentary variations in load reduced; not only is there greater economy, but the momentary fluctuations in load to be taken care of are much less violent. Another practical advantage is in the possibility of running all the cars at half speed in case of derangement to half the power-house capacity.

The use of recording wattmeters in power houses is advocated. By their means load curves may be established, representing fairly the power consumed to handle a given traffic, thus enabling a careful and intelligent comparison to be drawn between different days and seasons, and between days of similar character. Wattmeter readings on motor cars are of special importance, establishing as they do for the unit what the station readings show for the whole system.

The lack of instruction which many motormen receive is deprecated. It is advised that they be instructed in the car circuits, with a diagram showing the connections at each position of the controller; a plan commended is that of posting on car barns and in employees' rooms as a graphic object lesson, a chart of curves laid upon one plot, comparing the fluctations in current with the right and wrong methods of starting. A valuable aid also in the education of motormen is the use of the voltmeter on cars in plain sight, so that during the running the man can see the fluctuations of the instrument and note the results of incorrect handling as compared with the right method.

THE HOOKHAM ELECTRICITY METERS.

Mr. George Hookham, M.A., of Messrs. Chamberlain and Hookham, Limited, of Birmingham, has for nearly ten years been an indefatigable worker on electricity meters, with the result, as was to be expected, that the Hookham meters are well known and may be found on the circuits of a number of central stations. The patents for the continuous current type of meter date from March, 1887, and relate to patterns consisting essentially of electromotors doing work against Foucault or eddy currents, under such conditions that all other retarding influences are either negligible or are corrected.

With the object of obtaining a magnetic field suitable for the electromotor part of the meter, Mr. Hookham made a large number of experiments on different shapes and forms of permanent magnets, and the general results were embodied in a paper "On Permanent Magnet Circuits."* It was there shown that it was possible to construct magnets in which the residual induction might be considerable and permanent, provided the power of overcoming resistances in the circuit were proportional to the coercive force of the material used. In order to overcome a considerable air space resistance the dimensions of the bars must be such that the ratio of the total cross-section of the magnets to their length is very small compared with the ratio of the cross-section of the air space to the distance between the pole-pieces. The general rule was therefore deduced that if a permanent magnet is to be constant, the ratio of length of magnet to cross-section should not be less than 70 times the ratio of length to cross-section of air-gap. That is:

If A be the area of cross-section of air space,
L the distance between the pole-pieces,
a the cross-section of the magnets,
l the length of the magnet bars,
then the best relation is,

$$\frac{A}{L} = 70\,\frac{a}{l}.$$

On the basis of these tests it was found possible to get the best return for a given weight of steel, and when this object was attained, it was proved that the internal and external reluctances in the magnetic circuit were equal. The analogy between the electrical and magnetic circuits was believed to be, *mutatis mutandis*, one of universal application.

Messrs. Houston and Kennelly have recently given the scientific reasons for the correctness of Mr. Hookham's empirical rule, and have shown that certain conditions with respect to "seasoning" or ageing are necessary, in a "Contribution to the Theory of Demagnetisation."† From this investigation it appears that on the Hookham rule a factor of safety of three is allowed, that is to say, the demagnetising force is to the magnetising force as one to three.

Having arrived at the best dimensions for the magnets, Mr. Hookham constructed a number of meters, and after 18 months have elapsed, the outcome of all this work was presented to the Institution of Electrical Engineers on May 30th, 1889.‡ The meter as then made had a copper disc, on which the armature winding was mounted. The disc with its winding revolved in the field produced by a compound magnet, made up of 10 or 12 Tungsten steel bars, weighing about ½ lb. each. Iron pole-pieces were fitted to the ends of the magnets, and embraced a portion of the armature disc. The current was led into the winding by a pair of mercury commutators, the connections being so arranged that, when the two halves were dipping with their lower edges into the mercury on the same level, the effect was the same as when in an ordinary dynamo one brush presses on one side of the commutator, and the other on the opposite side.

As the disc revolved under the action of the current to be metered, eddy currents were induced in it at the sharp edges of the pole-pieces, and the work done on those induced currents varied as the square of the speed; the brake force varied as the speed, consequently the speed varied directly as the driving force. The field being constant and the armature winding carrying the current to be metered, the speed was proportional to the current.

When this meter was shown at the Institution, Mr. Crompton remarked that by his tests "this form of meter registers in favour of the company supplying at very small loads, although it is correct at ordinary loads," and accounted for this by supposing that the braking action of the Foucault currents had not sufficiently compensating effects at the lower portion of the range. On this point a user of these meters remarked that he thought Mr. Crompton was wrong in his facts with regard to these peculiarities, but in any event he was quite sure that the theory was inaccurate.

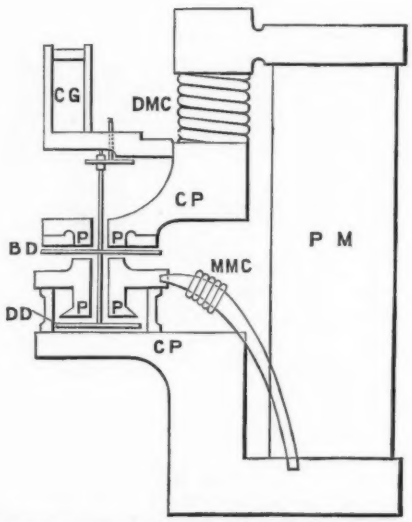
In the early forms of meter a magnetic shunt was placed across the poles of the magnets, and the constant could be maintained even if the induction varied by suitably adjusting the shunting bar. For currents exceeding 20 ampères

* *Philosophical Magazine*, February, 1888.
† *Electrical World*, Vol. xxv., p. 582, May 18th, 1895.
‡ *Journal Inst. Elec. Eng.*, Vol. xviii., p. 688.

the meter was wound with fine wire, and across the terminals a platinoid strip of sufficient section to carry the maximum current was placed. In 1890 Mr. Hookham constructed a meter on the principle which has since been adopted in the Elihu Thomson integrating wattmeter, but did not proceed with this form. The main current was carried by a heavy copper strip winding, laid horizontally; in the space formed by the winding a ball armature of fine wire was borne by a horizontal arbor, to which also was fixed the pair of commutators, a copper brake disc and the first wheel of the counting train. The armature was placed in shunt, and the heavy winding in series with the supply circuit, and in principle the meter partook of many of the features of the Elihu Thomson type.

The continuous current meter as now made is practically a different instrument from its predecessors. The only portion remaining unaltered is the permanent magnet field. The lower pole-piece is now formed into a mercury cup. In this a copper disc, carried by a vertical spindle, floats, and as the main current is admitted to the mercury bath circumferentially, and taken off at the centre, the disc, being in a strong magnetic field, is caused to rotate. On the same spindle a copper brake disc is fastened so as to lie parallel to the driving disc. The permanent magnet therefore supplies the flux for both discs, the air-gaps in which they work being in series.

The compound permanent magnet is formed of a number



C G, Counting gear; P M, Permanent magnet; C P, Cast pole pieces; M M C, Main magnetising coil; D M C, Main demagnetising coil; P, Pole pieces facing discs; B D, Brake disc; D D, Driving disc.

of special steel bars magnetised to saturation, and then reduced so as to reach an induction value that may be taken as sensibly constant. These bars are enclosed in a brass tube, and are clamped between cast-iron end pieces, from which wrought-iron cylinders connect to the pole pieces proper. The latter are kept at a fixed distance apart by means of a brass cylinder, whose axis is in the same straight line with the axes of the wrought-iron magnetic connectors.

The mercury cup for the driving disc is formed on the top of the lower of the two working pole pieces, and is bounded on its periphery by a ring of copper, which is nickelled on its inner surface to resist the amalgamating action of the mercury. An iron cover holds this ring in close contact with the pole piece, and this cover is so formed, that there is very little chance of the mercury being spilt when the meter is being removed, or is in transit, while it also acts as a director in distributing the magnetic lines of force in the most advantageous position with relation to the driving disc.

This disc is made of copper, as it carries the current to be metered, but it has fastened to its upper surface a disc of red fibre to act as a float, so that at small loads the vertical spindle bears upwards on a jewelled bearing, but when the upper range of the load is reached, the rotatory motion of the mercury causes the spindle to bear with its lower end on a hard steel bearing. As a result, the starting friction is reduced, and the heavy tear and wear is taken by the hard steel, leaving the jewel to come into use when its value is greatest.

The current connections in the meter are from a terminal secured to the base to the copper ring already mentioned, thence radially through the mercury bath and the driving disc towards the centre, where it is taken off by a plug inserted in the centre of the lower pole-piece. From this point it passes through the main winding on a magnetic shunt bar, which bridges that portion of the magnetic circuit containing the driving disc, and next through the main coil on the upper wrought-iron cylinder, leaving this coil to find its way to the other terminal to which one of the lamp leads is connected.

We will now briefly explain the method by which the braking action is compensated. On the vertical spindle, above the driving disc, the brake disc is fixed. This is made of an alloy specially mixed so as to give a very low and constant electrical resistance. The disc rotates between the upper portion of the cover to the mercury cup of the driving disc and the upper pole-piece. Each of these are slotted radially for about half their useful diameter, so as to cause eddy currents to be induced in the brake disc, and the amount of metal cut away by the slots is arranged to leave the central portion almost saturated. This results in a compensation for change in the induction produced by the magnets, for since,

the driving force $\propto$ the induction,

and the brake force $\propto$ the square of the induction,

a balance between the lines of induction carried by the slotted portions, tending to produce eddy currents, and the unslotted portions, not so operating, is upset when the total number of lines of induction varies, and the tendency is to maintain more nearly constant the number that pass between the slotted portions, so that the brake force is adjustable, rising and falling as the driving force varies, should the magnets alter from any cause. Within the range of variation that takes place in practice, the meter is compensated.

Another compensation introduced in the later types of meter corrects for the change in the coefficient of fluid friction that occurs at moderately high speeds. It is evident, from Froude's and Yarrow's experiments, that fluid friction follows a law which involves a varying power of the velocity for different velocities. To allow for this, the flux operating on the driving disc is made to depend in some degree with the current. The current coil on the magnetic shunt bar, and that on the upper wrought-iron cylinder, give magnetic forces of different sign, but equal magnitudes. The flux through the magnets is therefore constant, and does not vary with the current; but, since the magnetic shunt bar is across the mercury bath section of the magnetic circuit, the flux in this portion is increased at the higher parts of the range. The driving force is thereby increased, and corrects for the change in the coefficient of fluid friction.

From what has been said, it will be seen that this meter is of the class in which the Faure, Siemens, Teague, Ferranti, and Hartmann & Braun instruments would be placed, but it possesses features of peculiar interest in the compensating devices:—The double bearings and float, for bearing friction; the slotted and solid pole-pieces, for change in flux; the magnetic shunt, for change in fluid friction.

In addition to the advantages attaching to the old forms of Hookham meter, this type has eliminated the objections so frequently urged against the mercury commutators, and has thus removed a fruitful source of trouble. Its resistance is small, its energy consumption is low, since the current coils have only to give a small magnetic force, and no shunt coil is used for any purpose.

(To be continued.)

HOW TO TEST A TURBINE.*

By SAMUEL WEBBER.

The editor's recent inquiry, "How to Test a Turbine," came to me most opportunely, for it reached me at the time when I had just finished re-examining and recalculating the heaviest turbine test I ever made, and one of the heaviest that ever

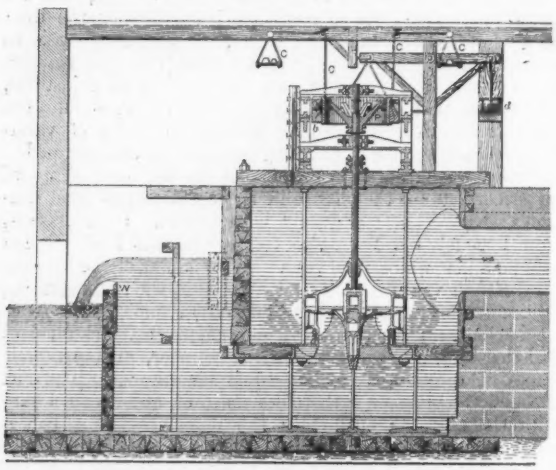
* *Cassier's Magazine.*

was made, *i.e.*, of a large turbine in a cotton mill, giving 472 horse-power under a head of 29½ feet, and over 80 per cent. net effect from the water used.

The owners of the mill were not satisfied with the practical results of the wheels, when the two wheels which were expected to drive the mill under 32 feet head, did not do it, and a third "spare wheel" had to be called on, and my advice was asked in the matter. I accordingly looked up my old note books and went over the matter again, finding no error in my original calculations, but, instead, finding the real cause of their trouble, in the insufficiency of the tail race to carry away the water from the wheels.

The wheel I tested used a little over 10,000 cubic feet of water per minute at the test, which, under the full head of 32 feet, would have been about 10,500 cubic feet, or 21,000 for the two wheels, and 31,500 for the three. The tail race was 30 feet wide, but the water had to pass through an arch under a railway, only 25 feet wide, about 100 feet below the mill, and the consequence was that the water was set back on the wheels, so that the head was only 29½ feet, the same as made by my weir at test, and the power realised consequently the same, or only 470 horse-power, instead of 530, which it should have been for each wheel.

So much for preliminaries. Engineers know what a Prony brake is, and that it is the usual instrument for determining the power given off by any prime motor, such as a water-wheel or steam engine. To those who are not engineers, let me say that it is the simple application to a friction pulley, placed on the shaft of a wheel or engine, of a brake, similar



Vertical Section of Turbine Plant with Testing Apparatus Applied.

to the brakes used to check a train on a railroad, by which the speed of the wheel or engine is regulated according to the pressure applied to the brake. This pressure being known and the revolutions of the friction pulley counted, it is easy to ascertain the foot pounds controlled by the brake, and from them to determine the horse-power.

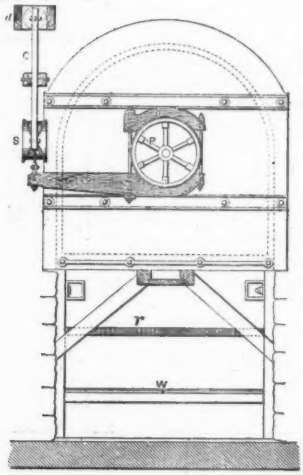
This form of testing apparatus derives its name from an eminent French engineer, Prony, who applied it for such purposes somewhere about the end of the last, or the beginning of the present, century. The principle of it is that a weight, held out steadily at the end of a horizontal lever, by the friction of a pulley, which is clasped by jaws at the other end of the lever, is the same as if the weight were lifted at the speed at which the point of attachment would rotate, if the weight did not hold it stationary.

It follows that a weight of 10 lbs. hung on a lever 5 feet and 3 inches long, or the radius of a circle measuring 33 feet in circumference, if held up steadily by a friction pulley at a speed of 100 revolutions per minute, would be equal to 33 × 100 × 10, or 33,000 foot pounds, or one horse-power. From this basis the power of a turbine is ascertained. We must have a suitable friction pulley, a brake lever with its clamp and bolts, the necessary weights and a timing watch. In addition to these, a hydraulic regulator, or "dash-pot," to steady the motion, first introduced by the late Uriah A. Boyden, and the apparatus for lubricating and cooling the pulley, are necessary.

I can find no better illustrations of the apparatus used for testing a turbine on a vertical shaft than the accompanying ones from the *Journal* of the Franklin Institute, of that used by the late James B. Francis to test a Swain wheel at the Boott Mills at Lowell, Mass., U.S.A. In these

P is the friction pulley,
b is the brake,
c are counterbalances to take the load of the brake off from the wheel shaft,
l is the bent lever or scale-beam for transferring horizontal motion to a vertical lift,
s is the scale-pan for the weights.
d, the dash-pot,
w, the weir for measuring the water, and
r, the rack for smoothing the water after leaving the wheel.

I copy this illustration as representing the simplest and easiest form of brake procurable and as effective for all moderate powers, say up to 300 H.P., as any more expensive form made of metal, although in the test of the 500 H.P. wheel, above referred to, the brake was made of two sheets of boiler iron, each nearly a semi-circle, and hinged together so as to almost clasp the pulley. These were lined with wood. One end of one of them was bolted to the brake lever, and the free end of the other was drawn up to it by an eye-bolt with a powerful screw cut on it, which passed through the lever and through a nut cut in a gear, which, in turn, was operated by a pinion on a hand-wheel shaft.



A Top View of the Plant Shown on the Opposite Side.

In the illustration the brake was closed by the nuts shown on the two bolts passing through it. These were screwed up by a long wrench, and this is usually sufficient. It will also be noted on an examination of the cuts that the arms of the friction pulley are not cast in one piece with the rim, but are a separate "spider," bolted to lugs on the inner surface of the rim. This is to prevent fracture of the pulley by expansion of the rim from heating, which is common in a long or heavy test, although it may be obviated, to a great extent, by the use of strong "ropy" soapsuds as a lubricant, instead of oil, and the continuous application of a thin jet of cold water to the wheel in the openings left by the jaws of the brake. This dilutes the thick soapsuds, and has proved, by many years' experience, far the most satisfactory friction lubricant for wood upon iron that the writer has ever tried.

The pulley should, if possible, be a flanged one, so that the brake may fit into it as into a saddle; if not, the brake must have side flanges, so as not to slip off the pulley sidewise. The rim of the pulley must be thick and strong enough to sustain a pressure of at least 50 pounds per square inch when in motion, and the writer has put them to a strain as high as 75 pounds per square inch, though he would not advise it, as so high a pressure is difficult to lubricate properly and handle steadily.

In preparing for a turbine test, the pulley is the first thing to be secured, and the rule usually adopted by this writer is to ascertain first, approximately, the power to be transmitted and the revolutions per minute of the shaft of the wheel.

He has found that 2,750 foot pounds per second, or 5 H.P., can be safely handled for every square foot of pulley surface moved one foot per second, or that a pulley containing 10 square feet of surface, or $3\frac{3}{16}$ feet diameter, by 1 foot face, at 100 revolutions per minute, or $16\frac{2}{3}$ feet per second, will be sufficient to control $83\frac{1}{3}$ H.P. The writer has gone as high as 9 H.P. per square foot of surface per second. A pressure of 5 H.P., or 2,750 lbs., is equal to 19 lbs. friction per square inch, or, if the friction be taken at 50 per cent., to 38 feet per square inch pressure, at about which Mr. Francis's "Swain wheel tests" were made. It will be perfectly safe, however, to add $\frac{1}{6}$th to this load, or to say that such a pulley at such a velocity would test 100 H.P.

The next point is the brake, which, as shown in the cut, should, with its shoe, clasp the pulley from opposite sides, letting each bear on from $\frac{1}{4}$ to $\frac{1}{3}$ of the circumference. This leaves two open spaces for the cooling water to be applied. The lubricant, of which I have already spoken, should be constantly fed on from a can holding from 1 to 2 gallons, and kept supplied by an attendant. This can should be supported on the brake with a pipe leading to the interior face, at the point where the pulley enters, and then by a set of "herring bone" grooves, spread over the whole face of the pulley, but which should not cut through the outer edge of the rim. The pipe from this can should be about $\frac{3}{4}$-inch in diameter and supplied with a valve by which the flow of the lubricant can be regulated. A stream of the size of a goose-quill will do for a small pulley, or of a lead pencil, for a pretty large one, with the aid of the water thrown in at the openings.

The writer has tried metallic brakes and oil, but does not like them, and if they are made of a flattened tube, with a water circulation, they are very expensive, and inaccessible for all ordinary practice. An iron pulley, a wooden brake and plenty of soap are always to be had, and the most convenient in use.

The brake should be made of some sound, strong timber. The writer prefers white oak or rock maple, and the bolts which draw it together should have square heads, countersunk in the "shoe," to keep them from turning round when the nut is screwed up. The size of timber for the brake may be determined by the formula in any engineer's pocket book for a beam loaded at one end.

The length of the brake lever is a matter worthy of serious consideration, for a little forethought here will save a great many figures in computation and the liability of many errors. This does not seem to have occurred to the early experimenters, for I find in Mr. Francis's "Tests of the Tremont Turbine" that the length of his lever was 9·745 feet; the vertical arm of his bell crank side beam was 4·50 feet, and the horizontal one 5 feet, making the real radial length to which the weights were applied 10·827778 feet. In his Swain tests the brake lever was 10·760 feet and the bell crank arms 5 feet and 4·495 feet respectively, making the length to be used in calculations 11·969 feet. Mr. Mills in his tests of the Swain wheel, gives the following dimensions: Brake lever, 8·164 feet; bell crank, 4·4955 vertical, and 5·0027 horizontal, making effective length 9·085 feet and circle of said radius 57·083 feet.

All these odd lengths and extra decimals make the calculations from them very tedious, and the writer has adopted the plan of making his brake lever equal to the radius of a circle, which should represent an integral part of a horse-power, *i.e.*, either 33, 66 or 99 feet, if the count be taken in revolutions per minute, or of 55 feet if the number of seconds occupied in making 100 revolutions be counted. These lengths of radius are:

	For a	33	feet circle,	5	feet	3·024 inches.
	"	66	" "	10	"	6·048 "
	"	99	" "	15	"	9·072 "
and for	"	55	" "	8	"	9·042 "

For all practical purposes these decimals of an inch, being all less than one-tenth, may be safely disregarded. Mr. Francis once said to me in regard to these matters: "What is the use in wasting time in elaborating the decimals of one per cent. to three or four figures, when the daily atmospheric changes in a cotton or woollen mill, or machine shop, affect belts, bands and lubricants, so as to vary the power required from 5 to 10 per cent. every day?"

(*To be continued.*)

OPENING OF THE BRISTOL ELECTRIC TRAMWAYS.

The Bristol-Kingswood electric tramway system, which we exhaustively described in last week's issue, was inaugurated by the Bristol Tramways and Carriage Company, Limited, the owners of the line, on Monday last, 14th inst., with the usual ceremony and local festivities, which were carried out with a dignity befitting the occasion, and on which we offer everybody concerned our hearty congratulations.

All along the route the streets were gay with bunting, whilst here and there garlands of flowers were displayed. The weather proved highly favourable. Early in the day great animation prevailed in Old Market Street, and before the cars were sent on their first run the thoroughfare was crowded with people as far as West Street. The directors of the company invited upwards of 200 guests to take part in the opening ceremony, and these included public men of Bristol and suburbs, men prominent in electrical engineering, and others to whom such an occasion would prove of special interest. Twelve o'clock was fixed as the hour of departure, but long before this there were visitors at the terminus, where eight motor cars had been drawn up on a side line for immediate use. Initial steps were taken towards bringing about the Kingswood extension in 1891, when a provisional order for carrying out the work was obtained, but it was not until the modified regulations recommended by the Joint Committee of both Houses of Parliament affecting electric traction were known that the Bristol directors felt justified in making headway. Mr. J. Clifton Robinson, C.E., who was the first general manager of the Bristol Company, and who, by the way, has subsequently acquired great experience of electric traction in America, was consulted by the directors, and formulated a scheme for extension to Kingswood. His report was of a highly encouraging nature, and the directors, accepting his recommendations, instructed their engineer, Mr. Joseph Kincaid, M.Inst.C.E., to carry out the work, the necessary powers being obtained by the company in 1894. The undertaking really involved the construction of some two miles of new line; but, in addition, as we have already stated, it was deemed advisable to pull up the section laid for horse car work between Old Market Street and St. George, in order that there might be a substantial road-bed fitted with new steel girders throughout the whole distance. The most modern overhead wire system has been adopted under the best expert assistance available, the British Thomson-Houston, Limited, being the contractors.

The Bristol-Kingswood district is about as difficult a part for electric traction men to try their powers upon as could be found in this country, on account of the irregularity of the road. The heavy gradients and other difficulties presented have, however, been well overcome, as was evidenced by the easy running on Monday last.

There was only one incident which caused more than usual interest along the route, and that was in connection with the journey of the second car. The incident proved with what ease and rapidity the tramcars can be brought from a good speed to a complete standstill. The car referred to progressed with special caution till clear of the dense crowd which reached West Street, and then put on increased pace. In Clarence Road a vehicle blocked the way directly in front of the car. The driver of the car was equal to the emergency, and showed the efficiency and capability of his apparatus to perfection by bringing the conveyance to an immediate standstill.

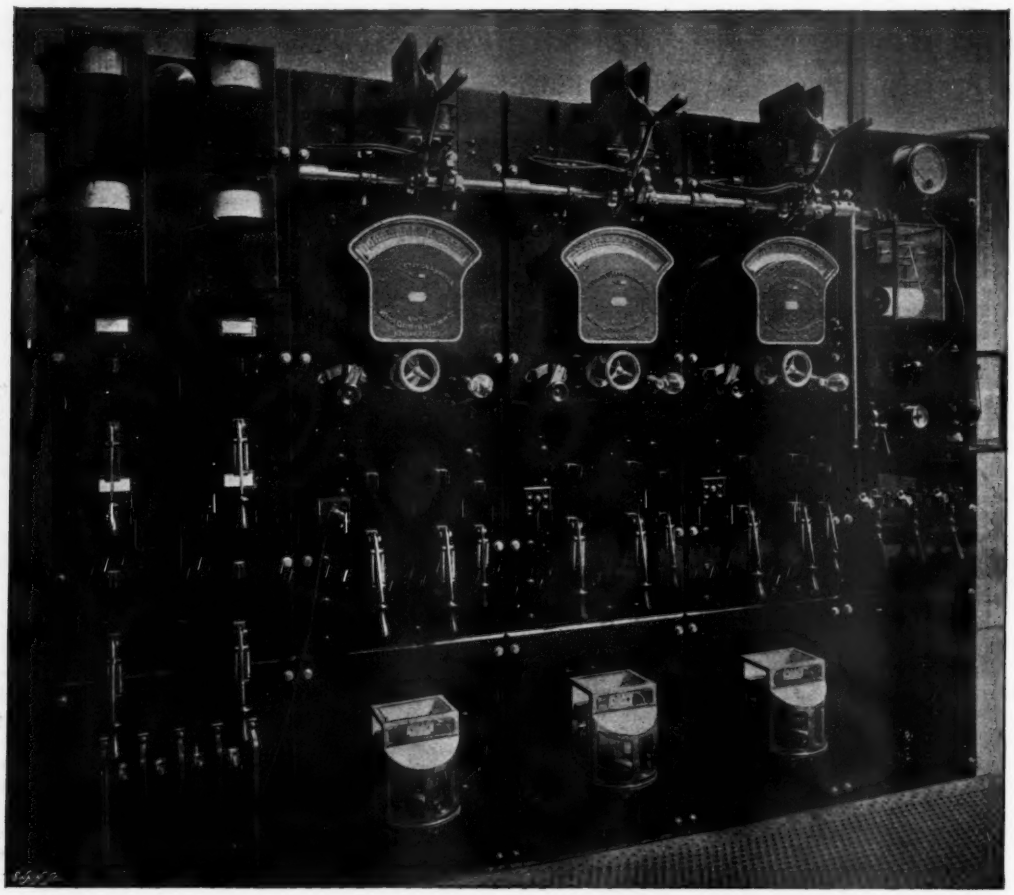
The first car was sent forward at 12.25, the second following a couple of minutes later. Kingswood was reached at 12.55, the journey having occupied as near as possible 30 minutes. At the terminus the cars were drawn up in a double line for the ceremony of formally declaring the line open. After a speech by Mr. Wm. Butler, the chairman of the company, the return journey was commenced, a stoppage being made at the power house for the party to inspect the machinery.

Luncheon having been served in the Grand Hotel Rooms, the usual toasts were honoured. Prof. Silvanus P. Thompson, in proposing success to the Bristol Tramways Company, said it was true there were already two electric tramways in this country, that in Leeds and that near Birmingham, but they

were both of them more or less of an experimental kind, and they knew that in the time which had elapsed since they were designed and set on foot there had been an enormous development, not only in the Continent of Europe, but far more particularly in the United States and Canada in this matter of electric traction. The line at Bristol was really the pioneer line for the electric tramway, and he congratulated them heartily. He was not a lover of any unnecessary overhead lines. On two occasions when he had been in the United States he had made special inspection of the overhead erections made there in the absence of a grandmotherly Board of Trade to prevent work being put up that was not solid. Ten years ago a great lot of the overhead work in the United States was of such a kind that it certainly would not be tolerated in England for a day, and it was not tolerated in the States many days. On the last visit he came away convinced that the multitude of overhead lines there for all sorts of purposes, the one which did least to disfigure the landscape, was least difficult from the point of view of traffic, and certainly least risky for the safety of the public, was the good, solid modern construction put up for the purpose of running electric tramcars. Therefore, it was rather surprising that there still were some who seemed to have some kind of prejudice against the use of overhead lines properly and solidly constructed for this purpose. They all knew in London last year the gentlemen of the London County Council in their wisdom saw fit to throw out a scheme for enabling another electric road to run through a part of the West End towards Acton. They had the idea that nothing could be more hideous or detrimental than the overhead construction. Having seen the construction on the Kingswood line they would be able to disprove the idea.

Mr. George White (the managing director), acknowledging the toast, remarked that he did not despair of seeing electric cars running up St. Michael's Hill and through the heart of Cotham and Redland districts. The conception of the present scheme was due to Mr. J. Clifton Robinson. Of course they received the greatest possible assistance in the carrying out of the plans from Mr. Kincaid, and they had been exceptionally fortunate in their selection of contractors. The way the Thomson-Houston Company had carried out the work had impressed him considerably. They had been fortunate in associating with them Mr. Blackwell and Mr. Dawson, who had done the work on the ground, and of whose ability and technical knowledge he had the highest possible opinion.

We can endorse everything which was said in favour of the line and those who had to deal with its construction, especially Messrs. Blackwell and Dawson, and we believe that the Bristol-Kingswood electric tramway marks a new era for electric traction in this country, and it will be safe to prophesy that it will, in the immediate future, be the means of developing to a very large extent this very important branch of the electrotechnical industry in which England is lamentably behindhand.



Bristol Electric Tramway Switchboard.

We were unable to include in our last week's account of this line a photographic view of the switchboard with the diagrammatic sketch of the board which we then gave. In the above illustration our readers will very readily follow the arrangements. As we have already said, the three middle panels are for the three generators, while the panel on the right hand side is the one which carries the Board of Trade instruments. The automatic circuit breakers which cut out the generators from the bus bar are shown on the top of the board, the Weston ammeters, the regulating devices and switches, being placed underneath. We committed a slight error in our description last week when we said that the line feeders were of Silvertown manufacture. We should have said they were made by the British Insulated Wire Company.

CORRESPONDENCE.

Electric Lighting in Spain.

It is very pleasing to notice the prominence that you have given in your last issue to the letter of my colleague, the editor of *Madrid Cientifico*, and my only object in writing you is to confirm the statements made in his letter.

There is plenty of work in Spain (or, rather, the Peninsula), for English electrical manufacturing firms; but the latter must be prepared to compete on "marginal profits" for the work.

The German and Swiss firms do this in every instance, and the consequence is that a considerable section of the work naturally passes their way.

The aim of the municipalities of Spain is undoubtedly to utilise electrical energy in every possible way.

I shall be very pleased to afford every information to English manufacturing firms upon any question arising upon any contract that may be open for public tender throughout the Peninsula, or to give them intimation and particulars of any such work on their communicating with me.

I am quite sure, knowing how impartial your remarks invariably are, that a considerable misconception of the circumstances attending these Spanish undertakings must have prevailed with you, when making the remarks referred to by Signor Luis de la Pena.

The Editor, *El Ingeniero Espanol.*

October 14th.

[We are obliged to our correspondents for the useful information which they have given in regard to the electrical industry in Spain. The instances to which we referred, of no tenders being sent in, were doubtless, as stated by our correspondent last week, understood by Spanish firms as mere custom to comply with the requirements of Spanish law. The bare announcements received by us repeatedly that tenders were invited, and none sent in, naturally led us to the opinions to which we gave expression in our leaderette.—Eds. Elec. Rev.]

The Paralleling of Compound Dynamos.

The theoretical conditions under which two compound wound dynamos, A and B, say, are usually considered as able to give out equal currents to a common pair of bus bars are, that

$$\frac{E}{E_1} = \frac{r + R}{r + R_1}, \text{ where}$$

E = fall of potential in armature, series winding, and cable connections of A.
E_1 = fall of potential in armature, series winding, and cable connections of B.
r = resistance of the armature of A.
r_1 = " " " B.
R = " " series winding and cable connections of A.
R_1 = resistance of the series winding and cable connections of B.

Under these conditions, A and B would run perfectly in parallel. Such an arrangement, however, is not stable, and any variation of one of the quantities specified might result in one of the machines being saddled with all the load, and the additional duty of driving the other as a motor. For this reason it is customary to connect the positive brushes by means of a cable of low resistance. Such a connection ensures against the polarity of either machine being reversed by current from the bus bars, but does not completely ensure against one of the machines being driven as a motor, by current from the other machine passing *viâ* the special brush connections, under certain circumstances.

The use of the special brush connection renders the above equation for equal currents applicable only in the case where

$$r = r_1 \text{ and } R = R_1,$$

and where, consequently, $E = E_1$, if the conditions of running are to be such that no current, under normal circumstances, shall pass between the machines.

Consider the case where the armature resistance of A (r) is greater than that of B (r_1), and assume that the resistances of the series windings, &c., are equal, and that the armatures are delivering equal currents.

The fall of potential in the armature of A is C r, and that in the armature of B is C r_1. Since $r > r_1$, the potential at the brush of B will be greatest, and current will pass through the special brush connection and the series winding of A to the bus bars. Hence, ammeters fixed on the switchboard and connected in the machine circuits, would indicate more current from A than from B, although the two armatures are really delivering equal currents.

Consider, next, the case where the armatures have equal resistance, but where the series winding and cable connections of A to the bus bars have a greater resistance than those of B, and assume that ammeters on the switchboard, and connected in the machine circuits, to indicate equal currents. In this case the fall of potential in the series winding &c., of A, is C R, and in B is C R_1.

Since $R > R_1$, the difference of potential at the brushes of A must be greater than that between the brushes of B, and current will pass through the special brush connection from A to B and to the bus bars. In this case the ammeters indicate equal currents from each machine, when, as a matter of fact, the difference in the currents delivered by the armatures may be considerable.

Hence we see that ammeters, in the machine circuits, are not reliable guides in estimating the output of compound dynamos running in parallel, unless they are connected between the brush and its connection with the series winding.

It becomes very necessary, then, in order to properly apportion the loads between the machines at work, that the proportions of the resistances referred to should be accurately adjusted. Small differences of potential at the ends of the special brush connection may give rise to comparatively large currents, owing to the low resistance of the cable forming this connection. In the lighting station with which the writer is connected, the method of running adopted is to adjust the speeds of the machines until there is no current passing through the special brush connection. When this condition is attained the relative resistances of the armatures is a matter of indifference, so far as apportioning the load is concerned, and it is only necessary to have the resistances of the series windings and cable connections adjusted inversely as the maximum rated current output of the machines in order to obtain the currents which they are designed to give.

The absence of current in the special brush connection is shown by the use of polarised needles, which are wound with a few turns of coarse wire, and connected *as a shunt to the special brush connection.* The pointers of these needles stand vertically when no current is passing, and point towards the machine sending current when deflected. The speed of the machine is then adjusted until the pointer is again vertical. As a matter of fact, with fairly good governors on the engines, very little adjustment is required.

J. Pigg.

Professional Etiquette.

Referring to your very interesting article, lately published, on the "Professional Etiquette of Consulting Electrical Engineers," I feel unable to resist the temptation to describe an experience I have recently had which quite convinces me that the things you describe actually can happen, and that your description is in no way exaggerated.

A few days ago I received a visit from a gentleman who introduced himself as a consulting electrical engineer, offering his services in the preparation of specifications, &c., for any electric lighting work I might have in hand on terms designed to be most alluring to an architect. I was assured that a very large number of architects, in good practice, had availed themselves of the "valuable services" the itinerant consultant offered.

In all professions, I think it will be admitted that dignified etiquette precludes the consultant from touting all over the country, either personally or by deputy, pushing his claims just as any ordinary bagman pushes his wares.

I enclose for your use the consultant's card, and my own

Architect.

Information Wanted.

Can you tell me, in your next issue, the present value of founders' shares, and 7 per cent. cumulative preference, in the Chloride Electrical Syndicate, Limited, of Manchester, or name of secretary and address?

J. P. T.

[The shares of this syndicate are not officially quoted, therefore we are unable to help our correspondent as to their present value. The address of the company is 16, Victoria Street, London, S.W., and Clifton Junction, Manchester. —Eds. Elec. Rev.]

I am at present interested in the application of electricity to the extraction of copper direct from the copper ore.

I understand that a good deal of work has been done in this line of late, and should be pleased if any of your correspondents could put me in the way of getting the latest information, either in any articles that have been written on the subject, or on any published work.

Thanking you and your correspondents in anticipation.

Copper Ore.

The Choice of Tranformers.

Referring to "S. R. C.'s" letter in your issue of September 27th, the 1,500 kilowatt transformer I instanced as representing English practice was taken haphazard, and was a commercial transformer, not specially made for testing purposes. Such transformers are manufactured by the firm alluded to in my article on the "Choice of Transformers" in considerable numbers.

"S. R. C." considers an iron loss of 79 watts at a frequency of 125 to be very large. I do not deny that transformers may be designed with much smaller iron losses, say 40 watts or even less; but such transformers will be expensive on account of the large quantity of copper which must be put into them.

When sending in a tender for an installation, first cost is frequently, I might say generally, the chief consideration; therefore high transformer efficiency is sometimes sacrificed to considerations of cost. It is satisfactory to know that the leading firm which "S. R. C." alludes to is able to turn out commercial transformers of such high efficiency.

If "S. R. C." would give further particulars as to the construction of the transformers in question, I, and doubtless many of your readers, would be very interested. "S. R. C." has evidently misunderstood a statement made by me in the above-mentioned article, to the effect that the iron losses would be reduced from 79 watts to 32 watts if the transforming ratio were altered from $\frac{2,000}{100}$ to $\frac{1,000}{100}$.

If "S. R. C." will refer again to the article in question, he will find that the assumption is made that the sectional area of core and the number of primary turns should remain constant.

The alteration in the transforming ratio would therefore be made in the number of secondary turns, not in the primary turns, as "S. R. C." assumes.

This explanation should satisfy "S. R. C." as to the truth of the assertion in question.

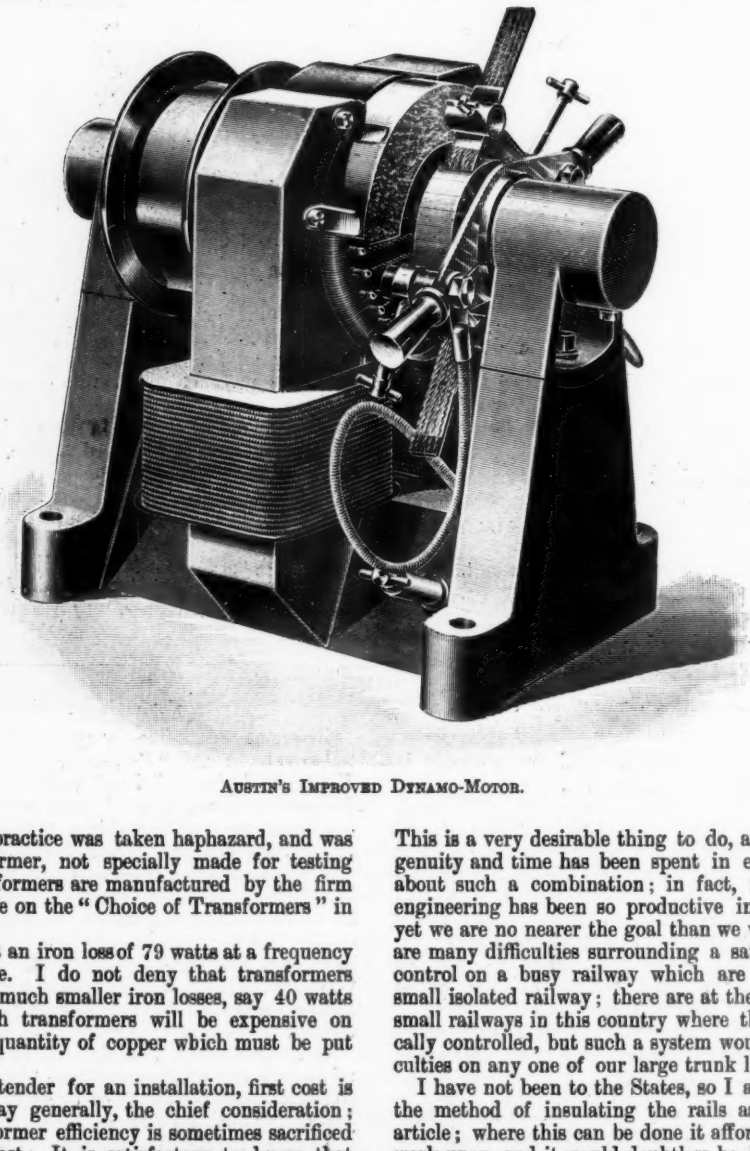
George Adams.

Bedford, *October 8th*, 1895.

Block Signalling.

I notice in your issue of the 4th instant an article on "Block Signalling," recommending interlocking the electric with the mechanical signals on railways in this country. This is a very desirable thing to do, and a good deal of ingenuity and time has been spent in endeavouring to bring about such a combination; in fact, no branch of railway engineering has been so productive in patents as this, and yet we are no nearer the goal than we were years ago. There are many difficulties surrounding a safe system of electrical control on a busy railway which are entirely absent on a small isolated railway; there are at the present time several small railways in this country where the signals are electrically controlled, but such a system would present many difficulties on any one of our large trunk lines.

I have not been to the States, so I am unable to criticise the method of insulating the rails as referred to in your article; where this can be done it affords excellent ground to work upon, and it would doubtless be interesting to many of your readers to know from someone who has seen the system working in America, how they accomplish this, and if it is



Austin's Improved Dynamo-Motor.

satisfactory. Are the sleepers covered with ballast as is necessary in this country? Are they creosoted? and with regard to the sections of line, what is the average length of the sections?

My experience of insulating the rails in this country is not satisfactory. I have tried this in tunnels, and inside covered stations which are protected from rain, and yet the insulation was so low as to render it almost impossible to work with any degree of safety; the washing of a train of carriages inside a station was sufficient to break down the insulation at once. I have not found any difficulty in insulating the fish-plates, and so divide up one section from another on a straight line of rails; but I do think there would be some difficulty in doing so in crossings and junctions run over at a high rate of speed.

I agree with you the present system of block signalling cannot be regarded as satisfactory; at the same time I must confess no system has yet been devised that approaches the degree of safety and freedom in working the traffic that would justify the large expenditure necessary for establishing and maintaining such a plant.

Zero.

IMPROVED DYNAMO-MOTOR

The illustration on the previous page shows an improved "Infant" dynamo-motor which is being placed on the market by Messrs. Austin and Co. The framework and magnets are in one casting of steel. The magnet coils are wound on separate bobbins of very high insulation, and can be lifted off for inspection at any time. As shown, the pulley is a double flanged one. This is accurately machined, polished all over, and balanced carefully. The armature is of special construction, and is so made that it should be impossible for the core to work loose. The way this is built up admits of the circumference and sides being perfectly true, and makes a well-balanced armature, without weighting in any way. The armature and pulley are not keyed to the spindle, as is usually done; but the bosses of both are clutched together, thereby ensuring positive driving and greater convenience in taking apart.

The commutator is made of hard drawn H.C. copper, and insulated with mica. It is held together by end washers in such a way that the segments cannot be knocked either in or out. There are no lugs on the segments; both sides are straight, and the face is made just wide enough to suit the width of the brushes, and to allow for the necessary end play. This makes a very neat and simple commutator, and one that is easily trued up, at any time, or as easily renewed. Instead of the usual lugs, each segment has a connecting wire soldered carefully to its inside edge. The wires are brought through suitable openings in the inside washer, and are bent well out of the way. Such a commutator enables the makers to shorten the machine considerably. The armature is well protected by a brass shield, while the brush holders are said to be simple. The rocker is made of brass. All the brasswork is highly polished and lacquered, and is made from hard rolled and drawn metal, not one casting being used.

The bearings are self oiling and dust proof. A sleeve is mounted on to each end of the spindle. The sleeves are much larger than the spindle in diameter, and have a good length, the bearing surface being unusually large. The sleeves run in copper bushes, made from hard drawn copper tube. The bush has a convexed ring fixed on the outside, that rests in the bearing, and allows the bush to adjust itself to the spindle. End thrust is taken up by copper discs dropped into the bottom of bearing, previous to inserting the bush. The bush is kept in position by an oil-tight ring. The bearings are oil retaining, and therefore require little further attention. They can be cleaned out and fresh oil added while the machine is running. New sleeves, bushes, thrust discs and commutator can be supplied from stock at once. We are informed that the machine is very highly finished, and has a very pleasing appearance.

All the wearing parts are made to standard sizes, and can be renewed by anyone. The machines are made in four sizes only, and give, when running as motors, $\frac{1}{6}$, $\frac{1}{3}$, $\frac{3}{4}$, and $1\frac{1}{2}$ actual horse-power, respectively. When used as dynamos they give out 200, 400, 800, and 1,600 watts. A 400 watt dynamo, weighs less than 60 lbs., and has overall dimensions of $9\frac{1}{2}$ inches × 12 inches × 10 inches high. The armature can be taken out for examination instantly. The spindle and sleeves are made of steel. The machines are said to run perfectly noiselessly, and without the least vibration. Messrs. Austin are making a speciality of these four machines, and have laid down special tools for their production.

BUSINESS NOTICES, &c.

Action for Nuisance Dismissed.—At Worship Street Police Court last week, proceedings were taken against the National Telephone Company, Limited, for allowing a nuisance on their works at Spitalfields, by the sanitary authority of the parish. The evidence of two sanitary inspectors went to show that an objectionable effluvium was traceable to the company's works, where it was found a process of vulcanising the wires was carried on. After hearing evidence from both sides, the magistrate said there was no preponderating evidence on either side. He thought, judging by the evidence that had been given, that it was a case in which he should not interfere, and it would therefore be dismissed, defendants costs being refused.

Bankruptcy Proceedings.—Under the failure of Mary Ann Hillock, trading as the Medical Electrode Company at 146, Southampton Row, W.C., accounts were issued last Saturday from the London Bankruptcy Court, showing debts £1,521 6s. 2d., and assets *nil*. The debts, which number over 260, appear to be almost entirely for advertisements, most of which were, the bankrupt alleges, improperly contracted by her late partner. The bankrupt also attributes her insolvency to bad trade consequent on the failure of a certain Medical Battery Company, and to her illness.

The adjourned meeting of creditors interested under the failure of Ronald A. Scott, Limited, of Acton Hill, W., was held on Thursday, 10th inst., at Temple Avenue, E.C. Statement of affairs showed total liabilities expected to rank for dividend, £5,934: assets, *nil*. After the Official Receiver had submitted his report, Mr. Scott was examined regarding certain patents, and the estate was left in the hands of the Official Receiver.

On 3rd inst., Edgar Haworth Berry, formerly carrying on business as an electrical engineer and contractor at Burnley, came up at the Burnley Bankruptcy Court for his adjourned examination. The bankrupt did not furnish complete statement of receipts and expenses as requested by the Registrar, and the examination had been adjourned once or twice for him to do this. On 3rd inst, bankrupt also failed to fully satisfy the Registrar's demands, and his examination was adjourned *sine die*.

Dissolutions of Partnerships.—Messrs. T. C. H. Martin and W. G. Johnson, formerly carrying on business as yacht, launch and boat builders, and fitters and electrical engineers at the Launch Works, Strand-on-the-Green, Chiswick, as Martin & Johnson, have dissolved partnership as and from 5th inst. by mutual consent. Mr. Martin will receive and pay debts to and owing by the late firm.

Messrs. G. F. Sanders, Albert Sanders and Arthur Sanders, formerly doing business at Hockley Street, Birmingham, as chandelier manufacturers, under the style of John Sanders, have dissolved partnership so far as concerns Albert Sanders from June 7th, 1895. G. F. and Arthur Sanders will continue the business and attend to the debts of the late firm.

Messrs. T. Malson, W. A. Malson, and S. R. Malson, hitherto carrying on business at Chesterfield and Newbold, as electric fuse makers, under the style of the Patent Electric Shot Firing Company, has been dissolved by mutual consent as and from October 11th.

Liquidation Notices.—Notice is published in the *London Gazette* to the effect that meetings of the Hope-Jones Electric Organ Company, Limited, held at Birkenhead on September 10th and 25th, decided that the company be wound up voluntarily, Mr. R. S. Blease, of Fenwick Street, Liverpool, being appointed liquidator.

It is also officially announced that at meetings held on September 21st and October 10th, at West Street, Finsbury Circus, the shareholders in the St. Martin's Electrical Manufacturing Company, Limited, approved of the contract to be made between the company and one Joseph Hill for the sale of the business, plant, materials, goodwill, &c., and to wind the company up voluntarily for the purpose of carrying out the proposed agreement, Messrs. T. D. Dundas and C. Hancock being appointed liquidators.

British Steam Generator and Refuse Utilisation Company, Limited.—A petition presented by the Hon. C. A. Parsons (C. A. Parsons & Co.) for winding up is to be heard at the Law Courts on 30th inst.

Catalogue.—Mr. John Spencer, of Wednesbury, has just issued a new and neatly compiled catalogue of iron and steel tubes of all kinds, as manufactured at the Globe Tube Works.

Change of Address.—Mr. G. C. Fricker, M.I.E.E., is removing his offices from 46, Queen Victoria Street, E.C., to 149, Fleet Street, E.C., to which address all communications should be sent.

Not Guilty.—At the County of London Sessions on Monday, Charles Lucas, 39, electrician, was charged with stealing a quantity of electric wire, value £4, the property of his employers, Messrs. Pritchetts & Gold, electrical contractors, of 31, Soho Square. For the defence, witnesses were called who gave accused 25 years' good character, and urged that a mistake had been made. The jury, after retiring, returned a verdict of not guilty, Lucas being immediately liberated.

Search Light.—Messrs. Baxendale & Co., of Manchester, write bringing before our notice a rather novel use of the search light which they have recently had to deal with in connection with the strike and riots at Messrs Gartside's Works, near Stalybridge. They say that: "We received instructions from this firm to fix one of our ship canal search light plants at their works, with the idea of preventing the strikers from maliciously setting fire to the temporary sheds erected for the protection of the men at present employed. A few hours after the receipt of their order we had this plant running on the top of the works, and it is now being used nightly in conjunction with the police force established at the works, to scour the surrounding country, and for illuminating the various parts where pickets are placed." It is said that the light enables Messrs Gartside to dispense with a considerable number of temporary police. Messrs. Baxendale are very busy just now with installation work, having in hand, amongst other contracts, the lighting of the Manchester and Salford Ship Canal Docks and sheds on the alternating high-tension system, and a number of arc and incandescent lighting installations in Manchester, Oldham and Dublin.

Electric Heating Apparatus.—Some novelties in the direction of electric heating apparatus are being introduced by Mr. Octavius March, of Southwark and Kensington. Fig. 1 shows his patent self-contained electric curling tongs, which can be used with any electric light circuit, or with a portable battery. They are heated in 30 seconds, and will retain a uniform temperature as long as required. A patent swivel attachment which is fitted prevents the cord twisting when in use. Fig. 2 shows March's patent electric heater for fluids. As will be understood from the illustration, this

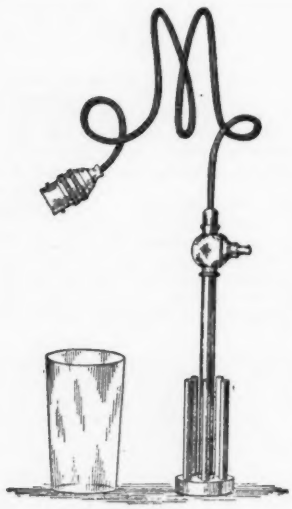


Fig. 2.

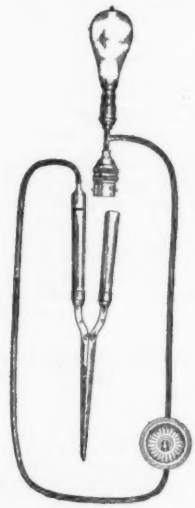


Fig. 1.

heater is so designed that the whole of the heat generated is enclosed by the fluid to be heated, and thus the heat is not wasted in first heating the containing vessel. It is claimed that the apparatus can be used in any vessel, and is small enough to stand in an ordinary tumbler. We understand that it will boil half a pint of water in three minutes, and is particularly suitable for heating wines, milk, soup, &c., as, being silver-plated, it can be readily cleaned. It can be instantly attached to a lamp-holder on electric light circuit. It is constructed for use on 100-volt circuit, but can be supplied for use with any other voltage.

The Electrical Company, Limited. — This firm decided at its last board meeting to materially reduce the prices in their new catalogue shortly to be issued, due to the improvement in trade prospects, and the increased facilities for manufacture secured by the enlargement of their works and steadily increasing demand for their standard types of apparatus. Our readers will remember the announcement we made last week that one company was advancing its prices for dynamos for one of the reasons that the Electrical Company reduces them, *i e*, improvement in trade.

The Electrical Company, Limited, as sole representatives of the Allgemeine Elektricitäts Gesellschaft, of Berlin, inform us that that firm carried out the Port Electric Light and Power Station, at Copenhagen, and *not* "The General Electricity Company."

The "I.E.C." Dry Cell.—It is now some years since the first dry cells were put on the market, and nearly every month brought a new type of these batteries into existence. A battery is now put forward by the International Electric Company, of 55, Redcross Street, E.C., which they name the I.E.C. dry cell. It is claimed that some of the I.E.C. dry cells have run as long as 768 hours uninterruptedly, short-circuited with a 5 ohm bell. The very same cells having had a rest of a fortnight, were then again run for 343 hours consecutively, and allowing a further interval for recuperation, the cells yielded another output of 104 hours, giving a grand total of 1,215 hours before exhausted, a result which justifies the makers to proclaim these cells as practically inexhaustible. The fact that the company will exchange any cell found defective within 12 months, provided it has not been short-circuited intentionally, goes far in support of this contention. The International Electric Company are, so we learn, willing to give cells free of charge to any public institution interested in the comparative tests of dry cells, and as the price is a very moderate one, the trade will certainly do well to see whether the same favourable figures are obtainable when put to practical work.

ELECTRIC LIGHTING NOTES.

Ashton-on-Mersey.—A sub-committee have reported on their visit to Broadheath (Manchester) electric lighting works, and the meeting with Sale sub-committee.

Ashtead.—The Epsom Rural District Council has acceded to an application by Mr. Cadett for permission to cross the main road at Ashtead with an underground cable for electric lighting.

Aberdeen.—A new tower is to be erected at the termination of the extended north wing of Marischal College. It is to be lighted by electricity, and the contract may be given out shortly.

The public library is to be lighted electrically, at a cost of about £140.

Alderley Edge.—Negotiations have been in progress between the District Council and Mr. Clirehugh, electrical engineer, of Manchester, who is anxious to purchase the provisional order. This has seemingly awakened the Council to their position, and they are to hold another meeting to consider the question.

Bath.—Mr. Alex. McTavish has asked the Markets Committee to allow him to light the markets by electricity, the power being obtained by means of an independent gas engine. Mr. McTavish is to bring up a report.

Birmingham. — An extensive installation of electric lighting and distribution of power is in course of construction at the Birmingham Technical School, according to the plans and specifications of Messrs. Henry Lea & Thornbury. The new building contains 134 rooms, besides staircases, corridors, and lavatories, the whole of which are lighted by electricity. The generating plant consists of three Tangye gas engines, each capable of developing continuously at least 53 brake horse-power when running at 160 revolutions per minute. Each engine has two extra heavy fly-wheels, 7 feet in diameter and 10 inches wide. The three engines, together with three compound-wound dynamos by Thomas Parker, Limited, Wolverhampton, are placed in a room in the sub-basement. The dynamos run at 900 revolutions per minute, and are driven by leather belts. The engine room also contains a small Tangye gas engine for starting the main engines. A gallery erected above the dynamos carries the switchboard, upon which are mounted a Lord Kelvin's voltmeter and other instruments necessary for observing and regulating the electric current. Special connections are employed for enabling the three dynamos to be run together in parallel without risk of reversal of the current in any dynamo. At one end of the gallery is a combined motor and dynamo. This machine takes a part of the current from the main dynamos at 110-volt pressure, and adds as much pressure as is necessary to charge 58 storage battery cells, which were made by the Electrical Power Storage Company, Limited, each cell containing 34 plates. These cells are for lighting the corridors, staircases, and such rooms as may require artificial light when the machinery is not running. They are only capable of supplying a small proportion of the total number of lamps installed. As soon as the demand reaches about 100 ampères, one of the main engines is started, and another and a third when required. From the switchboard, which contains 23 circuit switches, electric mains are led to the various distribution boards situated on the various floors throughout the building, some for lighting purposes, others for motive power. The principal of the school (Dr. Sumpner) has, in conference with the engineers, given special consideration to the character of the lighting of the rooms throughout the building, so as to adapt it as much as possible to the various wants of the classes. In some rooms the usual 16 C.P. glow lamps are used, in others a smaller number of 50 C.P. glow lamps are found to be more suitable, in others Crompton arc lamps of the ordinary pattern are used, while in others, again, inverted arc lamps are employed. These latter have large reflectors underneath the lamps, which throw the light upon whitened ceilings. In the mechanical drawing office particularly, this kind of light is much appreciated, and in many of the workshops, where the shadows cast by ordinary lights are objectionable, the inverted arc system has proved a great success. There are very few ornamental fittings in the building. They are confined chiefly to the committee room and the examination hall. The latter will have eight six-light pendants in bright brass, made by Winfields, Limited, of Birmingham. Obscured lamps without shades will be used. Electricity is freely used in the school for motive power purposes. There are 15 electric motors in the building, of a total of 46 horse-power, varying from one to 7 horse-power each. In the electrical engineering room there will be an admirable set of machines, specially arranged by Dr. Sumpner. In this room the electrical connections have been so designed that each machine can be used either as a dynamo or as a motor, so that its value for teaching purposes is doubled. Continuous and alternating currents will be produced by these machines for experimental purposes. A separate set of storage batteries, and a specially-arranged switchboard help to render this room very complete for its intended purpose. The first instructions were given to the contractors on May 23rd last, and the light was used for school purposes on September 16th, and has since then been nightly in use without interruption. There are in all about 806 glow lamps and 80 arc lamps.

Bolton.—The Guardians on 4th inst. decided to light the Union offices (excepting the board room and lavatories) with electricity, and to invite tenders for the work.

Bradford.—At the last Town Council meeting the chairman of the Gas Committee made his half-yearly statement regarding the profits on the gas and electricity works. For the latter works he stated that the capital account was £67,111 10s. 1d., and the income for the year, £6,185 8s. 3d. The expenditure had been £3,008 14s. 1d. The trade profit amounted to £3,176 14s. 2d.; interest and sinking fund absorbed £2,190 5s. 9d., and the net profit was £986 8s. 5d. as compared with £2,138 19s. 4d. for the preceding year. He would like to say that the Electricity Department, though they were handicapped by their boilers, and the fact that the new engines and plant had not been delivered, was in a fair way of realising Alderman Priestman's prediction, and becoming an appreciable source of income.

Battersea.—The Vestry has decided to apply for a provisional order to light portions of the parish by electricity.

Bangor.—The Town Council, on 9th inst., decided to apply to the Board of Trade for an electric lighting license, authorising them to supply electricity within the limits of the borough, and such parts of the parishes of Llandegai and Penter as may be thought advisable.

We understand that if the works are carried out, Mr. Medhurst is to be retained as electrical engineer, at a remuneration of £650, to include his expenses; if not, he will be paid £50 for his report and assistance.

Brazil.—The *Financial News* Brazil correspondent reports that it is stated that Cataguazes is to be lighted with electricity, also that the quarantine station at Ilha Grande is to be similarly lighted. The cost of the electric light plant for Pará is estimated at 3,200,000$000. The city will be illuminated with 1,800 incandescent lights of from 16 to 25 candle-power, and 86 arc lights of 2,000-candle-power. The power will be furnished by eight steam engines, and will be sufficient not only for lighting the streets, but also for 10,000 private lights each of 16-candle-power. The plant will be furnished by the firm of Siemens & Halske, of Berlin.

There recently arrived at Pernambuco the electric light plant for the city of Maceió.

Brierley Hill.—Inquiries are being made by the District Council as to the probable cost of lighting the district by electricity in place of gas.

Bury.—A Committee has been appointed to consider the question of lighting the town by electricity, and the best system.

Chelsea.—The Chelsea Electricity Supply Company have suggested to the Chelsea Guardians that the new buildings should be wired for electric lighting. A committee has to consider the matter.

Colombo.—An Indian contemporary states that the electric lighting of the Colombo new post office is far more expensive than was anticipated. The Government allowed only Rs. 20 per night, but the actual cost comes to Rs. 75 per diem. Efforts are being made to reduce the cost.

Denbigh.—A proposal to introdnce electric lighting is under consideration.

Dewsbury.—During the month of September 3,377 units of electrical energy were sold, notwithstanding a large increase in the gas consumption.

East Grinstead.—The District Council have resolved, "in view of the attitude of the gas company," to grant Messrs. Owen and Pike an interview *re* electric lighting.

Hull.—Mr. Barnard, the newly appointed electrical engineer, attended the meeting of the Electric Lighting Committee on 10th inst. The new boiler at the central station has been tested by the insurance company, and found satisfactory.

Ilfracombe.—The District Council came to a wise decision on Saturday last. It was resolved not to take any steps in the matter of purchasing the gas works, but to make inquiries as to electric lighting.

Italy.—A central station has recently been established at Villa d'Olmo, near Como. The plant comprises two 13 H.P. gas engines and two Siemens dynamos, one giving 60 ampères at 115 volts, and the other 40 ampères at 175 volts. There is also a battery of 63 Tudor accumulators.

Killarney.—The municipal elections, which were contested on 15th inst., were stated to be fought purely upon the question of electricity *versus* gas. It is to be hoped the result of this election will be the end of the silly squabbling for which Killarney has been conspicuous when discussing the electric lighting question during the last year or two.

Leeds.—The City Council has decided to sell all its electric lighting plant, save one gas engine. The Council is now, as we have already stated, taking its supply from the Yorkshire House-to-House Company's mains, and has consequently no further need for its own plant.

The Leeds International Exhibition, which was opened last week, is lighted by 18 1,000-C.P. arc lamps, and a large number of incandescents.

New 1,000-Unit Machine at Deptford.—The London Electric Supply Corporation have just set to work a new 1,000-unit fly-wheel alternator made by Messrs. Ferranti, which, running at 156 revolutions, gives 10,000 volts direct. The machine forms an important addition to the generating plant of the Deptford works, and places them in a very strong position, especially in view of them supplying the Metropolitan Company with energy sufficient to make good the loss sustained by the destruction of the Sardinia Street station. It is interesting to note that after the lapse of so many years since the starting of the 10,000-volt system, another machine should be ordered, and that 1,000-unit plant and 10,000 volts should be kept as the standard. The new machine is, of course, very much improved in design and construction, due to the greater experience gained since the 10,000-volt system was commenced in 1889.

Newport.—The electricity works of the Corporation were ublicly inaugurated on Monday, the 14th inst.

Neston.—A member of the District Council has visited the Continent, and come across a small village where the electric light is supplied very cheaply (1d. per light per night), and has, on his own responsibility, engaged the services of a London consulting engineer to go to Neston and report. The Council has appointed a committee to act regarding the matter.

Oxford.—The Corporation has accepted a scheme proposed by the Oxford Electric Company, Limited, for lighting the streets of the city by means of incandescent lamps, 24 of which are combinations having two 16-C.P. lamps each. The cost will be £652 per annum. A contract has been entered into for a term of six years, determinable at the end of the first three years, at the option of the Corporation.

Plymouth.—The Council had before it on 14th inst. the Works Committee's report on electric lighting, refuse destructors and electric traction, embodying the observations prepared by Dr. J. A. Fleming. Dr. Fleming says that if provision is made for the simultaneous use of 7,500 8-C.P. lamps, about 10,000 could be connected to the supply circuit. There should, however, be a reserve plant of about 30 per cent. The total capital outlay will be about £35,000. The probable revenue would be about £5,000 a year, and as the total operating cost can be brought within £3,500, there would then be £1,500 to pay the share of sinking fund and interest. When the lamp connection reached 10,000 8-candle-power lamps, it might be fully expected that a profit would be made over and above the amount required for working cost and interest. This estimate does not include the arc lighting plant, which would cost approximately £7,260 for a capacity of 90 arc lamps of 300 watt-power. These lamps would cost to maintain from £15 to £17 per annum, and would entirely replace the gas lamps over a street run of at least 12,000 feet, and probably over about three miles, while the average illumination of the street surface would be increased in some places tenfold. Dealing with the suggestion that a refuse destructor might be utilised for generating steam, Dr. Fleming says his opinion is that it would be unwise for the Corporation to embark hastily on any such scheme. It is perfectly certain than an amount of refuse destruction, equal to about 30,000 tons per annum, cannot possibly yield directly the amount of horse-power required in the electric lighting station at the hour of maximum load. In order to maintain 10,000 lamps of 8 candle-power, something like 500 or 600 horse-power must be available; but the direct heat from a refuse destructor would not probably amount to more than 50 to 60 horse-power. This power might, however, be utilised during the daytime, or hours of night, if the destructor station were placed in contiguity with the electric lighting station, but the latter should at first be made entirely independent, and the destructor be considered as a sanitary question only. The third point submitted to Dr. Fleming's consideration was that of electric traction for the tramcars. After discussing the merits of the various systems of applying electricity to this purpose, he recommends the adoption of the overhead or trolley supply system. Careful consideration should first be given to the operation of one line in the eastern part of the town, the system of power transmission being such as to be capable of being extended to lines running out in other directions if the results warrant further extension. There can be little doubt, he adds, but that the establishment of one such electric tramcar line, worked from a supply station placed in the Cattewater site, would show the advantages of electric traction over horse traction in respect and cost of working. His opinion is, however, that the generating machines necessary for supplying the currents for the electric traction should not be the same as those employed for the electric lighting. The cost he puts at about £15,000 per mile of double track, including the car equipment. The sub-committee is to visit several London and provincial electric lighting stations before anything further is done *re* electric lighting.

Portsmouth.—At a meeting of the Town Council last week, Alderman G. Ellis, J.P., Chairman of the Electric Lighting Committee, reported that they had purchased a Parsons turbo-alternator and generator for £1,759, of which £1,250 had been paid. People living near the station had complained of the noise, and the committee, therefore, wanted permission for Messrs. Parsons to take back the condenser for a further £100. There would then be a balance of £400 left. A new surface condenser, noiseless, and more economical of coal and water, was proposed. It would cost a little more than the balance. The proposal was agreed to. The committee was authorised to cut off the supply of electricity to any premises after giving seven days' notice. The committee was also authorised to expend £600 in the purchase of electric meters.

Prestwich.—The Chairman, at the last meeting of the District Council, asked whether it was not desirable that steps should be taken to procure a provisional order for lighting the district by electricity. The Town Clerk said the matter was hardly ripe at present for an application to be made. It would not be lost sight of. From the meagre report of these proceedings, which is published in the local paper, it would appear that it only needed the Town Clerk to give a personal (not legal) opinion upon the matter for it to be shelved for the time being. Surely there were some members of the Council who thought the matter and the time were both ripe for action. If not ripe now, when will it be? It is to be hoped the matter will "not be lost sight of." But if there is much delay a private company will, likely enough, step in and secure that which is ripe fruit, and when the local authority in years to come desire to carry it off, it may have to content itself with the over ripe, and have to pay a good price for it.

Reading.—The Electric Supply Company has served the Town Council with notices of its intention to proceed with the laying down of mains, &c., for the supply of electricity to a number of stated streets.

Reigate.—The Town Council had an animated and lengthy debate regarding electric lighting at the last meeting, the result of which was the appointment of a Committee to consider the question, and to consult expert opinion as to cost, &c. The legality of gas shareholders voting was questioned, and caused a good deal of disturbance.

St. James's (London).—The Vestry Works' Committee have presented a report as to the proposed electric lighting of Regent Street, Piccadilly, St. James's Street, and Pall Mall. Before anything is decided experiments are to be made in Regent Street with incandescent gas burners.

Stafford.—In presence of a goodly company, the electric lighting station was officially opened on Tuesday afternoon last, October 15th.

Tottenham.—Again the District Council has had the electric lighting matter before them, a company having written directing attention to an economical system of electric lighting. One member thought the Council should keep the work in its own hands. Question referred to the General Purposes Committee.

Wigan.—A sub-committee of the Council recently visited Leicester to see the electric lighting station, and also the works of Messrs. Fowler, at Leeds. They have now submitted their report. Mr. Holmes, in moving its adoption at the last Council meeting, hoped the Council would either take the work in hand at once or abandon the idea altogether. The probable expenditure was stated as £16,000. The report was adopted, the Council deciding to do without a specialist. The work will doubtless be pushed forward very shortly.

Wilmslow.—A company is desirous of securing a provisional order. The Council knew this when the electric lighting question came up at the last meeting on the proposition that the Council secure an order for itself. It was, however, decided to defer the matter 12 months. We question whether they will be able to shelve the matter in this way. The company in question will doubtless force them to consider it again ere that date.

Windsor.—On the motion of Alderman Dyson, the Council last week resolved upon the erection of a refuse destructor. A Committee was appointed to see the matter through.

Woking.—St. John's and Goldsworth Wards ratepayers want the electric light for their streets, and Messrs. New & Mayne have been asked the cost, which they estimate at £260, with an annual charge of £168 for current.

Yarmouth.—At the last Council meeting the surveyor reported that 135 more electric lamps had been applied for, making a total of 5,495. The expenditure during September was £133 4s. 10d., and the income £222 0s. 6d., leaving a profit on working expenses of £88 15s. 8d. The surveyor stated that the profits for August and September amounted to £142 4s. 7d., which just covers the loss on the first seven months' work. Any further profit earned this year will be devoted to the payment of rates, insurance, sinking fund, and interest, together amounting to about £850. The profit to be earned during the rest of the year is estimated at nearly £300, making the cost of the electric lighting works to the ratepayers about £550 for the first year's work. In explanation of the recent breakdown of the light, the surveyor said that the fuses would not stand the full load, but since then fuses had been fitted of triple strength.

The Town Council has resolved to erect a telephone line from the Town Hall to the Sanatorium, and also to the Corporation stables, at a total cost of £68 10s.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Electric Cranes at Dover.—It is stated that the London and Chatham Company propose to erect steam or electric cranes at Dover and Calais, to facilitate the embarkation and disembarkation of baggage from their mail packets. At Dover they will be assisted by the Dover Harbour Board, and probably by the Chamber of Commerce at Calais.

Electricity for Gold Extraction.—The statement of affairs of the Proprietary Gold Recovery Company, which has been issued by the Official Receiver, says:—"No dividend has ever been paid by the company. Its failure is attributed by Mr. W. Crooks and Mr. W. C. Johnson to the refusal of Mr. Hannay to practically demonstrate the method of recovering the gold from the cyanide solution by means of the electric current. On the other hand, Mr. Hannay states that he was always ready to demonstrate the process if suitable plant had been provided, and he attributes the failure to the depletion of the company's funds by the directors in the purchase of plant which was useless for carrying out his process."

Electric Traction in Italy.—Two further lines of electric tramways, known as the Ka Roma and Circon Vallazione lines, have just been opened for traffic in Genoa. The lines are on the overhead conductor system, and have been constructed by the Allgemeine-Electricitäts Gesellschaft, of Berlin.

Electric Traction in France.—A company is in course of formation at Lyons to be known as the Société des Tramways de Lyon-Croix-Rousse à Calnire, to construct and operate an electric tramway between Lyons and Calnire. Plans have been prepared for an electric tramway between Avignon and Sorgues.

Electric Traction in Germany.—A company has just been formed in Leipzig, with a capital of £225,000, to be known as the Grossen Leipzig Strassenbahn Gesellschaft. The company has been formed to acquire and convert the existing tramways in the town into electric lines. The horse tramway in the town of Ruhrort is also to be converted into an electric line.

Electric Tramcar Accident in America.—An accident occurred to an electric street car at Pittsburg, U.S.A., early this week. The car, over which the driver had lost control, left the rails while travelling at a high speed, and fell over an embankment, three persons being killed and nine seriously injured.

Glasgow Tramways.—As will be noticed elsewhere in this issue, the Corporation are inviting tenders for a new line of tramways, and for electrically bonding the rail-joints of the existing lines.

Leeds Electrical Tramways.—After a prolonged discussion, the Leeds City Council on Tuesday decided to adopt the electric system of traction for Leeds tramways. Several members of the Council advocated the cable system of haulage, which, however, it was explained, would entail greater expenditure.

Madras Electric Tramways.—Regarding the question of conduit *v.* trolley systems in their application to Indian tram lines, the *Madras Times* says the overhead system which is being adopted on the unopened sections of the Madras line, lends itself to much more rapid construction than was the case with the conduit system, "and the lines are now being laid down with almost magic speed, which contrasts pleasingly with the delays of the opening work. The difference is so great, that it is wonderful that the system was not adopted in the first instance." Our contemporary says it has from the very commencement expressed its conviction of the failure of the conduit system when applied in India. "And it was the adoption of the system in the face of strong opposition from shareholders which well nigh succeeded in bringing the Madras Electric Tramway to a permanent collapse. With the now obvious success of the application of electricity to traction in Madras, we may fain hope to see the element further adopted throughout the country."

Plymouth Proposed Electric Tramways.—Under our Plymouth "Electric Lighting Note" will be found some remarks by Dr. Fleming regarding a suggested line of tramways for Plymouth.

The Electric Traction Business.—We are informed that the president of the Tramways Institute of Great Britain and Ireland (Mr. W. J. Carruthers Wain, C.E.) is again visiting the United States and Canada on a mission of further inquiry into the question of electric traction, and to that end he will personally inspect all the newest and improved methods of traction in the States.

The Rathmines Proposed Tramway.—The scheme for laying an electric tramway from Rathmines to the sea was considered at a recent meeting of the Rathmines Ratepayers' Association, Mr. J. H. Ryan, C.E., and Mr. A. E. Porte, electrical engineer, explaining the project. The proposed route is from Castlewood Avenue, through Charleston Road, Ranelagh, Chelmsford Road, Appian Way, Clyde Road, to Ballsbridge, thence to Sandymount and Merrion. It seems the overhead wire system is not proposed.

TELEGRAPH AND TELEPHONE NOTES.

A New Atlantic Cable.—We understand that at the re-opening of the French Parliament, M. André Lebon, Minister of Commerce, is to bring in a Bill for the ratification of a convention concluded with the French Submarine Cable Company for the laying of a new cable between Brest and New York, with branches to the Antilles and Brazil. The existing cable, which has been in use since 1879, has, Dalziel states, been found insufficient for the traffic with New York, and especially for communication with the Antilles.

Australian Landline Interrupted.—We had recently occasion to refer to the interruption of the landline which unites the south of Australia with the two submarine cables at Port Darwin, to which route the Western Australian landline to the cable at Roebuck Bay is the only alternative. We now gather from a report made by the Superintendent of Telegraphs of South Australia last month, that "fault still exists on Western Australian line between Bremer and Esperance Bay. All business is much delayed. Can receive occasional batches of five or six messages." Thus it appears that, by the fortunate accident of these landlines not having been interrupted simultaneously, communication with Australasia has escaped another breakdown.

Exports of Telegraph Wire and Apparatus.—The export trade of this country in telegraph wire and apparatus connected therewith continues in anything but a satisfactory condition. During last month the exports only attained a value of £45,268, as compared with £49,820 in September, 1894. The depressed state of this branch of trade is well reflected in the returns for the nine months ending with September last, these showing only a total of £383,437, as against £1,304,594 in the corresponding period of last year, and £766,224 in the first nine months of 1893.

French Cable Steamers.—In the *Annales Télégraphiques*, May-June number just received, we note with pleasure that M. Ed. Morris, chief of the submarine service in France, continues his article to which we have already drawn attention. The present

article gives an interesting reference to the two cable steamers of the French Administration, the *Charente* and the *Ampère*, and a very full description of the former vessel. The article is well illustrated, and should be read by those interested in submarine telegraphy. We again remark the absence of the "ego," which disfigures so many of the publications of the present day, and the simple reference to the work of others makes the reader believe implicitly in the *bona fides* of the author.

Pacific Cable.—It is stated that a deputation from the Australian Agents-General will wait upon Mr. Chamberlain, on his return to town, on the subject of an Imperial subsidy to the Pacific cable and Pacific mail service.

Rhodesian Telegraphs. — The telegraph line from Fontesvilla to Cape Town, *vid* Salisbury, is about to be connected.

The Falkland Islands.—Writing to the *Morning Post*, C. E. Kelway, a former resident in these islands, says:—"If we were at war the ports on the South American coast would be practically closed to us as belligerents for naval purposes. . . . . If the Falklands were made an effective naval station our warships and those of the mercantile marine would have a rendezvous under all circumstances. Whatever it might cost, the Colony should be in cable communication with England *via* some other British possession, and irrespective of contact with any foreign country, as it goes without saying that the simultaneous cutting of telegraphic communication would, where possible, form the prelude of an act of war by any formidable enemy. On the principle that a part of a loaf is better than no bread, the 250 miles separating the islands from Sandy Point on the Patagonian coast should at once be bridged by a cable."

Telegraphs in Turkey.—An agreement has been made between the Turkish Posts and Telegraphs Department of the Turkish War Office with reference to the establishment of telegraphic communication between over 100 military stations in the country.

Telephonic Communication between Belgium and Germany.—On Tuesday last Belgium and Germany were put in direct telephonic communication with each other. Antwerp and Cologne are the extreme points between which conversations can be carried on, and the price for three minutes' use of the line varies from 1.25c. to 2 fr., according to the distance.

CONTRACTS OPEN AND CLOSED.

OPEN.

Ashington.—Firms desirous of tendering for the electric lighting of Miner's Hall, Ashington, should send at once their names and address to Boolds and Hardy, architects and surveyors, Morpeth.

Belgium.—November 8th. The Municipal Authorities of Tongres have extended the date for the receipt of tenders for the concession for the electric lighting of the town from the 10th inst. until November 8th. Tenders to be sent to the Conseil Municipale, Hotel de Ville, Tongres.

Edinburgh.—October 22nd. The Corporation invites tenders for carbons.

Glasgow.—October 22nd. The Corporation is inviting tenders for the construction of a new line of tramways, commencing at the termination of the existing tramways at Rockvilla and terminating at Saracen Cross, Possilpark. It is also prepared to receive tenders for electrically bonding the rail joints of the above-named tramways. Specifications and forms of tender may be had from Mr. John Young, general manager, 88, Renfield Street, Glasgow, where drawings may be seen and any information obtained.

Glasgow. — October 21st. The City Improvement Trustees are inviting tenders for supplying and fitting wires, lamps, &c., required for the electric lighting of the New Family Home in St. Andrew Street. Particulars from Mr. Wm. Arnot, electrical engineer, 75, Waterloo Street, Glasgow.

London.—October 28th. The Postmaster-General is inviting tenders for the supply of red fir telegraph poles, to be delivered in London, King's Lynn, or Sutton Bridge, and at Northumberland Dock (River Tyne), West Hartlepool, Hull, or Grimsby; and also for creosoting the poles with 10 lbs. or 12 lbs. of creosote to the cubic foot, as may be directed. The poles to be felled between November 1st, 1895, and February 29th, 1896, and to be delivered during the following summer at the port at which the creosoting is to be performed. Particulars may be obtained on application to Chas. E. Stuart, Controller of Stores, General Post Office, London, E.C.

Madrid.—November 15th. The Director of Public Works is inviting tenders for the concessions of the construction and working of a tramway from Madrid to Colmevar Viejo, with branches to Chamartin and Rosa. Security 12,505 pesetas. Particulars at the Direccion General de Obras Publicas (Ministerio de Fomento), Madrid.

Rangoon.—November 4th. The Municipal Committee is inviting tenders for electric lighting. Particulars to be obtained from Messrs. Ogilvy, Gillanders & Co., 67, Cornhill, E.C.

Saltash.—October 26th. Tenders are invited by the Town Council for lighting with gas, electricity, or otherwise the public lamps in the Borough, from January 4th, 1896, for such term as may be agreed upon. For further details see our Official Notices.

Southampton.—October 21st. Tenders are invited for supplying and fixing a gas-engine and mixing machinery for the treatment of sewage at the Platform Works, for the Corporation, in accordance with plan, specification, particulars and conditions to be seen on application to Mr. W. B. G. Bennett, borough surveyor.

Vienna.—November 14th. The Municipality of Vienna asks for tenders and plans for the construction and working of electric railways in and around the city. The notice may be seen at the Commercial Department of the Foreign Office.

CLOSED.

Bedford.—The following is a list of the tenders sent in for cast-iron lamp columns, globes, &c., for the Urban Sanitary Authority's electric lighting installation:—

	Cast-iron tops. £ s. d.	Sheet copper tops. £ s. d.
Bradley, W., Brighouse	449 0 0 (accepted)	519 0 0
Hollam & Co., London	540 0 0	660 0 0
Phœnix Foundry Company, Derby	579 0 0	—
Alloa Iron Company, Alloa	620 0 0	715 0 0
Ulverston Shutter and Lift Co., Ulverston	625 0 0	—
Cochrane & Co., Dudley	—	650 0 0
Sharpe & Co., Lancaster	632 0 0	782 0 0
Newton, Chambers & Co., Sheffield	650 0 0	800 0 0
Kilpin & Billson, Bedford	653 0 0	765 0 0
Pontifex & Co., London	700 0 0	950 0 0
Macfarlane & Co., Glasgow	811 13 4	890 0 0
Lloyd's Works, Abercarn	—	563 6 8
Ashmore, Benson, Pease & Co., Stockton	—	739 0 0
Goddard, Massey & Warner, Nottingham	850 0 0	910 0 0
Hart, Son, Peard & Co., Birmingham	960 0 0	—
Smith (Geo.) & Co., Glasgow	1,050 0 0	1,050 0 0
Mackenzie Bros., Edinburgh	—	1,350 0 0

Blackburn.—From the tenders sent in for wiring and fitting the Town Hall, the Council has accepted that of a London firm, which, all things considered, was lower by £60 or £70 than others. A local firm tendered £10 lower, but when the committee asked for supplementary tenders, drawings, &c., they found the firm selected gave better value to the extent named.

Harrogate.—Seventeen tenders were sent in for wiring the Council's new Baths. That of Messrs. Paterson & Cooper, for £412, was accepted. There will be 433 lamps.

Harrogate.—The following tenders have been accepted in connection with the Corporation electric lighting installation, Mr. George Wilkinson, M.I.E.E., being the Corporation's engineer:—

	£ s. d.
Boiler house plant.—Houldsworth & Sons, Bradford (without brickwork settings)	1,516 0 0
Steam alternator plant.—Ferranti, Limited, London (125-unit plants are substituted for 100-unit plants)	7,428 0 0
Switchboards and instruments.—Ferranti, Limited, London	671 3 0
High and low tension mains.—British Insulated Wire Company, Prescot (exclusive of service mains and accessories)	2,931 1 6
Transformers.—Brush Company, Queen Victoria Street, E.C. (exclusive of small sizes)	403 7 0
Meters.	Not let.
Overhead crane.—Southgate Engineering Company, Fenchurch Street, E.C.	190 0 0

Leyton.—The District Council has sealed the contract with Messrs. Spagnoletti & Crookes for supplying and fixing wires and fittings to the Public Offices and the Technical Institute.

Manchester.—For supplying the 15 tons of copper strip for use in connection with the Corporation electric lighting works, the tender of Messrs. T. Bolton & Sons, of Oakamoor, was selected and accepted.

Oswestry.—From the tenders sent in for supplying electric lighting to the Cross Market, the Council selected that of Mr. Reakes of Shrewsbury, which was the cheapest, *i.e.*, £52. There will be 6-500-C.P. lamps used. An agreement with the electric lighting company is to be entered into.

Shoreditch, E.C.—The firms tendering for insulated electric light mains, and conduits for the Shoreditch Vestry electric lighting installation were as follows, Messrs. Kincaid, Waller and Manville being engineers for the work:—

British Insulated Wire Company, Prescot, accepted for high-tension mains, largest tension mains, and conduits.
W. T. Glover & Co., Manchester, accepted for smaller low-tension mains.

The following also tendered:—

India-Rubber & Gutta-Percha Company, Silvertown.
Fowler, Waring & Co., North Woolwich
Henley's Telegraph Construction Co., North Woolwich
Callender Company, London
Siemens Bros. & Co., London
Reid Bros., London, tender for conduits only.

South Moulton.—The following is a note of the tenders sent in to the South Moulton Shirt & Collar Manufacturing Company, for wiring their factory for electric lighting and electric heating:—

	£ s. d.
Mavor & Coulson, without accumulators	198 0 0
S. J. Waring & Sons, London	203 10 0
J. A. Edmondson, Leeds	281 13 0
Messrs. Newton & Hawkins, Taunton (accepted)	282 0 0
H. T. Sully, Bristol	322 0 0
David McClure, Jun., Stockport	340 0 0
J. W. L. Paterson	352 0 0
H. F. Joel & Co.	394 0 0
Pettit & Hands	406 0 0
Walsall Electric Company, Walsall	412 4 0
Macdonald & Colledge	429 0 0
F. W. Ball	450 0 0
Acme Electrical Works	452 0 0
F. A. Glover & Co.	457 13 0
W. Mackie, London	470 0 0
Paterson & Cooper	515 0 0
J. C. Howell & Co.	558 0 0
Brush Electrical Engineering Company	565 0 0
Drake & Gorham	605 0 0
Geo. Hill & Co.	715 0 0

Stafford.—The following tenders were sent in for wiring and fitting the County Infirmary for electric lighting, Messrs. Kincaid, Waller & Manville being the engineers, and Messrs. Aston, Webb and Bell the architects:—

	£	s.	d.
Drake & Gorham, London (accepted)	397	0	0
Bennett & Druce, Preston	319	0	0
Lanak, Kendal & Co., Manchester	380	0	0
Paterson & Cooper, London	381	0	0
Liverpool Gas Fittings Company, Liverpool	434	0	0
S. J. Waring & Sons, Manchester	455	0	0
Corporation of Stafford Electricity Supply, Stafford ..	491	15	3
Lea, Son & Co., Shrewsbury	442	0	0
F. W. Ball & Co., Bristol	468	6	0
Strode & Co., London	500	0	0
Fowler, Lancaster & Co., Birmingham	475	0	0
Northern Counties Electrical Construction Company ..	586	10	0
Walsall Electrical Company, Walsall	623	15	0
T. Scott Anderson, Sheffield	550	0	0
Fletcher, Hirst & Co., Burnley	566	0	0
Laing, Wharton & Down, London	618	0	0
Corlett Electrical Engineering Company, Wigan ..	615	0	0
Spagnoletti & Crookes, London	677	0	0
W. O. Rooper, Stafford	663	15	1
Benham & Sons, London	836	0	0
Hall, Geary & Co., Burton-on-Trent	796	10	9

Wakefield.—The Corporation Electric Lighting Committee has accepted the tender of Messrs. John Fowler & Co., of Leeds, for two sections of the electric lighting scheme, the sum being £11,338; and also the tender of Mr. Thomas Smith of Rodley, Leeds, for an overhead crane, amounting to £253. The tender of the British Insulated Wire Company for the supply and erection of underground work for £3,192 was accepted, that of the Brush Electrical Engineering Company for the supply of arc lamps and posts for £252 10s., and that of the Westinghouse Electric Company for supplying meters for £233 18s. These sums made a total of £15,279 odd, against Mr. Hammond's estimate of £15,893. Messrs. Siemens Bros. & Co. offered to carry out the whole work for £15,900.

NOTES.

Mr. Franklin L. Pope Killed by Electric Shock.—It is with sincere regret that we learn of the accidental death of Mr. Franklin Leonard Pope, who was on Monday last making tests with an electric converter at his residence at Pittsfield, Mass., when he fell among a number of line wires, and received the full force of a current calculated at 3,000 volts pressure. A telegraphic despatch from New York states that the body of the deceased was terribly disfigured.

Mr. Pope was a past-president of the American Institute of Electrical Engineers, and a member of the London Institution of Electrical Engineers. He was without doubt one of the oldest and best known electricians in the States, and has been connected with the introduction of telegraphy and telephony there from the very earliest infancy of these sciences. For many years he was on the electrical staff of the Western Union Telegraph Company, but somewhere about the year 1880 he resigned his position for the purpose of practising as a patent agent and expert witness, in which spheres he had a very extensive business connection. Mr. Pope was also known as the advocate for the Westinghouse patents in the litigation which has arisen regarding them in the U.S. Courts. The deceased gentleman came to be so closely identified with patent and legal matters connected with the electrical business, that no electrical suit in the American Courts could be considered complete unless he was engaged on one side or the other. Regarding his literary productions, many of our readers will remember his excellent technical hand-book on "Modern Practice of the Electric Telegraph," for which there was such a demand, that in its enlarged and rewritten form it had, in 1891, run into its fourteenth edition. By others of our readers, his "Evolution of the Incandescent Lamp" will not have been forgotten. His other articles often graced the columns of the New York technical press, with which he was actively connected for some years, and were occasionally reproduced in the London journals. He was a frequent visitor to this country—the land of his ancestors—and no one who has met him will forget his genial and kindly manner.

Personal.—An interesting ceremony took place at Messrs. Browett, Lindley & Co., Limited, on Wednesday, 9th inst., when Mr. F. C. Gibbons (one of the directors of the firm) was presented with a handsome marble clock by the staff and employés as a token of their goodwill on the occasion of his marriage, which took place the following Saturday. All the employés were entertained to dinner by the firm on Saturday, October 12th, to celebrate the event.

Horseless Carriages.—The remarkable procession which heralded the arrival of the electric light at Tunbridge Wells on Wednesday last week, and which would seem, in the mind of the local reporters, to have eclipsed any civic or histrionic display, ancient or modern, included a petroleum motor carriage ("drawn on a trolley supplied by Mr. Smith") which Sir David Salomons had purchased, and allowed to be paraded through the streets in evidence of his enthusiasm upon the question of horseless carriages. Sir David's interest in the matter is prompted by purely patriotic motives, but he should repress his enthusiasm. A few days since he wrote to the *Daily Telegraph*, trying to prove that it is perfectly legal under the existing Acts to run horseless carriages upon the public thoroughfares. From his letter we extract the following passage:—

> Parliament, by passing the 1888 "Customs and Inland Revenue Act," has sanctioned this mode of locomotion, and no further legislation is required. Probably the reason why the public are unaware that they can obtain an Excise license for mechanical carriages is due to the fact that few people would think of looking at a "Customs and Inland Revenue Act" to discover whether horseless carriages may be run on English roads.

This communication was replied to in a subsequent issue by "Town Clerk," who has little faith in Sir David's authority on the construction of Acts of Parliament. He says:—

> There can be no doubt whatever that any carriage propelled by steam, petroleum, gas, or electricity, is a "locomotive" within the meaning of the Highways and Locomotives Acts. Sir David says that the framer of the Inland Revenue Act, 1888, drew a distinction between a self-propelled carriage and a locomotive, but a self-propelled carriage, whatever that expression may mean, is a *locomotive*, and a locomotive is a self-propelled carriage. . . . . But, says Sir David, it being necessary to take out an Excise license for a carriage (not a railway carriage) drawn by steam, electricity, or other mechanical power, the Locomotives Acts do not apply. . . . . The primary object of the Inland Revenue Acts is to obtain revenue by taxation, and not settle what may or may not be done on highways, and it is a cardinal rule of construction of Acts of Parliament that there is no repeal by implication where the objects of the statutes are different, and I fear we must wait for further legislation on the subject before we can safely run electrically or self-propelled carriages on highways without observing the rules and regulations of the Highways and Locomotives Acts.

Some further correspondence has since appeared in the *Telegraph*. Sir David states something which he says confirms

> His opinion that carriages propelled by mechanical power . . . . . are quite distinct from the traffic regulated by the Locomotives Act, and that horseless carriages have been permitted in this country since the passing of the Act of 1888.

Another writer affirms that carriages propelled by electricity do not come under the terms of the Highways Locomotives Act, that statute referring to smoke-emitting or fuel-consuming machines. He says that

> Whatever obstructive people may urge against the "Voitures Automobiles," as used in France, their arguments cannot apply to vehicles propelled by electricity. It is, he remarks, rather late in the day to argue that an electric carriage is not permissible in the streets of London, when it is a well-known fact that an electrical omnibus has over and over again, in the midst of the thickest traffic, threaded its way with perfect ease and security through the principal London thoroughfares.

While we do not care to express any opinion on the point at issue, we would remark that the writers appear to have overlooked the fact that the Chief Commissioner of Police took legal advice upon this very point a year or so ago, when an electrical van was plying in the streets of London, and he subsequently gave a decisive opinion that electrical, or similarly propelled vehicles, were locomotives within the meaning of the "Locomotive Act," and accordingly must be considered subject to the conditions given therein until some new Act was passed. The Electrical Trade Section of the London Chamber of Commerce discussed the question; the technical journals all gave it attention; and Mr. Shaw Lefevre with other members of Parliament took it up with a view to mending matters.

The exhibition of horseless carriages, to which we referred in our issue for October 4th, was opened on Tuesday last on the Tunbridge Wells Agricultural Show ground. At three o'clock, Sir David Salomons, by whom the show was organised, entered the ring in a petroleum motor carriage. His carriage was followed by others, one of which, built by Messrs. Panhard & Levassor, of Paris, was the property of the Hon. Evelyn Ellis, and is representative of the type of the prize winners at the Paris-Bordeaux race last year. There

was another vehicle of the Victoria stamp. A fourth contrivance was a barouche without its front wheels, the fore part of the carriage being supported by a small petroleum engine, built by Messrs. de Dion & Bouton. Three tricycles completed the list of exhibits. One of them is worked by a petroleum motor, with electric spark ignition, the weight being about 90 lbs. This was shown by Messrs. de Dion & Bouton, and is after the design of Count de Dion & M. Bouton. Another tricycle was exhibited by M. Guédon, for the Gladiator Cycle Company, of France. The horse-power is about two-thirds, the fuel is mineral naphtha, and the ignition by electric spark. This machine weighs about a hundredweight. The pedals are used to start with, but when the motor runs the pedals are automatically disconnected. On Tuesday, however, the motor did not seem to run, as the cyclists were busy with the pedals all the time.

Portable Electric Lighting Plants.—In a recent issue we referred to the portable electric lighting plants being used in connection with Buffalo Bill's Wild West Show in America. Mr. J. H. Vail, writing to our New York namesake, refers to a plant of somewhat similar character, which he believes was the first portable electric light plant, and which was successfully used during the celebrated J. G. Blaine campaign in an important parade, about October 25th, 1884. This plant consisted of a high-speed engine belted to an Edison bipolar dynamo, both mounted upon a large truck drawn by six of the largest horses in New York city. Steam was derived from the boiler of a steam fire engine, securely attached to the rear of the truck, and connection made to the boiler by a steam hose. The water supply consisted of two street-sprinkling carts, with hose connection to boiler feed pump. Four hundred incandescent lamps of 16 candle-power were supplied with current from this plant. Each lamp was fitted to the helmet of the individual men forming an electric light brigade. Six lamps were supplied to six mounted men in the front rank, and a 100 candle-power lamp on staff to E. H. Johnson, the captain. Eighteen lamps were used on the horses, three per horse. The brigade marched from the Edison Machine Works, then located on Goerck Street, to Madison Avenue; up Madison Avenue to Fiftieth Street, thence down Fifth Avenue to Washington Square, where the brigade was dismissed. Electric lights were successfully supplied during the line of march. The entire plant and equipment were hastily designed and put together in five days under Mr. Vail's supervision.

The Institution of Mechanical Engineers.—An ordinary general meeting will be held on the 23rd and 24th inst. at the Royal United Service Institution, Whitehall, when the following papers will be read and discussed:—On the 23rd, Mr. H. R. J. Burstall, of London, will read one on the "Electric Lighting of Edinburgh," while on the 24th inst. "The Report on the Lille Experiments upon the Efficiency of Ropes and Belts for the Transmission of Power," translated by Prof. D. S. Capper, of London, will be read. The last-named gentleman will also read a paper on the observations on the Lille experiments referred to above.

A Consulting Engineer's Lot.—The notion is prevalent that the consulting engineer makes a small fortune in fees received for work of any magnitude carried out for Town Corporations; but that such is not always the case may be gathered from the following paragraph from the *Western Mail*:—

> Mr. W. H. Massey's present engagement with the Corporation will terminate this week. Mr. Massey has, it is stated, been a considerable loser by the engagement, his out-of-pocket expenses, keep of office, &c., having amounted to £1,800, which exceeds his remuneration for services rendered by £200.

The Falls of Foyers.—At a meeting of the Inverness County Road Board, on Wednesday afternoon, the question raised by the operations of the British Aluminium Company, as to the alteration of the roads and the raising of the levels of three lochs in the Foyers district, was again discussed. The objections to the scheme which dealt with the alleged destruction of the Falls of Foyers were stated to be greatly exaggerated, and the board unanimously agreed to approve of the alterations and works proposed.

The Niagara-Buffalo Deadlock.—The New York *Electrical Engineer* follows up its previous remarks on this subject thus:—

> While far Sacramento has been celebrating with brilliant festivities her utilisation of power brought 22 miles, and while Salt Lake City is getting ready with alacrity for the transmission from the Big Cottonwood, which is to do so much for her industries, poor Buffalo that has counted fervently upon the coming of the power from Niagara to make her the first or second city in the Union, is to-day, it would seem, further than ever from realising her just hopes. For years past, Buffalo has looked upon herself as *the* city to be benefited by the utilisation of Niagara, yet to-day with two 5,000 H.P. generators running at Niagara and a third being put in position, Buffalo might as well be Boston, for any good the power is doing her. It seems to us that this is a most regrettable state of affairs, for Buffalo is the natural destination of a large part of the energy developed electrically at the Falls; but the Power Company and her Aldermen cannot hit it off at all, and the latest form of proposed contract has just been rejected. The main points that are objectionable in the unfortunate franchise are: The clause requiring the Company to construct and maintain poles and conduits sufficient for at least two other companies; the exaction that all wires may be ordered under ground at any time, which might be immediately after the poles were erected; the demand of an annual tax of 5 per cent. on the gross receipts; the limitation of the grant to 25 years, whereas the Company's bonds are 36 years, and the right to revoke the grant on 10 days' notice, which would obviously forbid the investment of capital. That the Company should object to such conditions after an investment of millions of dollars, and with a steady and growing demand for power outside Buffalo, is natural; and we do not see how it could do otherwise, although our sympathies are entirely with the citizens of Buffalo in their anxiety to make decent terms and get the power that their eyes and hopes have now been fixed on for years.

Gas v. Electricity.—Sir David Salomons, joining in a correspondence opened in the *Daily News* on the cost of gas and electricity, says that some years ago he made a long series of tests by taking Bray's and Sugg's nipples, which are those most common in use, off gas fittings in several houses, to a number probably exceeding 100. The average of the tests was under 10 candles, when the burners passed 5 cubic feet of gas per hour; the nipples tested being marked for 5 feet. Nipples quite new gave better results, but in a very short time deteriorated by dirt and dust settling on the orifices. It would have been a fairer comparison had Sir David stated how much an incandescent electric lamp which gives 16-C.P. when new for a given consumption of electrical energy, deteriorates in candle-power after a few months use.

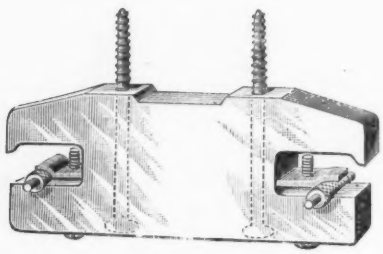
Southend Pier.—The pier account of the Southend Council Finance Committee shows that this undertaking has worked very profitably this season. The account shows a profit of nearly £3,000, which the Council has transferred to the borough fund account, and being equal to an 8d. rate, will meet the whole expenses chargeable to the borough fund, including school board precept and other items. It is stated that the profit is due to the great concourse of visitors to Southend this year using the pier. It would be interesting to learn to what extent the pier electric tramway has helped to earn this profit. The Council are now pressing forward with the electric lighting question, and Prof. A. B. W. Kennedy is to report.

The Lighting of St. Paul's Clock Dials.—Regarding the attempt to illuminate the dials of St. Paul's Cathedral clock, Messrs. Kendal & Dent write to the *City Press* suggesting several devices for accomplishing this. One of the courses they suggest is the removal of the central glazing, reverting to the original dials, and placing a ring of electric lamps around each dial, one lamp at, say, each of the hour numerals. They suggest, as an alternative, the illumination of the hands, or the tips of them. "This would be quite practicable by means of incandescent electric lamps, although some of the details might be a little troublesome to work out."

Trial of Oil Motor for Traction at Glasgow.—During the trial run of a tramcar fitted with a new oil motor, invented by a local engineer named Johnson, shortly after midnight on Tuesday in Glasgow, the oil tank was set on fire, and the car was burned as it stood in the centre of the street. Forty passengers, most of them town councillors, hurriedly left the car, and the flames were extinguished by the fire brigade. This occurrence can hardly be calculated to impress the Councillors of Glasgow favourably regarding the adaptability of oil motors for tramcar traction. Let them take example by Bristol.

Technical Education.—The South-West London Polytechnic Institute has been opened for technical education purposes. The curriculum for the present session includes mathematics, physics, and electricity, mechanical engineering, and other sciences, as well as several general educational classes. The principal, Mr. Herbert Tomlinson, B.A., F.R.S., presides over the Physical Section, where, both by lectures and practical work in the admirably equipped laboratories, a thorough course of instruction is given in heat, light, sound, electricity, magnetism, and electrical engineering. The chemical laboratories are designed and fitted on the best modern principles.

The "Ideal" Porcelain Cleat.—The Electric Porcelain and Manufacturing Company, of Trenton, New Jersey, are introducing to the electrical trade a new cleat, as shown in the illustration, called the "Ideal," which is claimed to



be the strongest ever made and the most perfect insulator. The glaze and body are simply earth, without any chemicals or metallic oxides, fused together at 6,000° of heat, making a vitreous composition which does not absorb moisture.

The Influence of the Bristol Electric Tramway.—As will be seen in another part of this issue, the electric tramway service at Bristol was inaugurated with sufficient dignity on Monday last. The principles and details of the system are too fresh in the minds of our readers to warrant us referring to them again. It is satisfactory to find, however, that the decision of the Bristol Tramway Company to use electricity is already influencing the minds of those who will materially affect the future of electric traction in this country. The Dover Corporation seem to be kindly disposed towards a traction scheme, involving an expenditure of some £50,000, a sub-committee of the Glasgow Corporation has been considering the question of introducing some form of motor on the eminently successful municipal lines, while the Leeds City Council have decided to adopt electricity for the whole of the tramways. These are signs of the times which are unmistakeable.

City and Guilds of London Institute.—A special course of four lectures on "The Principles of Thermo-Dynamics and their Application in Engineering," will be delivered by Prof. John Perry, M.E., D.Sc., F.R.S., on alternate Thursday evenings from 7.30 to 9 o'clock, commencing on Thursday, October 24th, at the City and Guilds Technical College, Leonard Street, City Road, E.C. Students are supposed to be already possessed of some knowledge of heat and thermo-dynamics, and also of the differential calculus.

NEW COMPANIES REGISTERED.

West Australian Electrical Trunk Power and Lighting Company, Limited (45,550).—This company was registered on October 8th with a capital of £510,000, in £1 shares (10,000 deferred) to carry on in West Australia and elsewhere the business of electricians, electrical and mechanical engineers, suppliers of electricity, and the business of an electric supply company in all its branches. The subscribers (with one share each) are:—C. G. Kistner, 93, Finsbury Park Road, N., secretary; H. J. Kidd, Milton Avenue, East Ham, clerk; L. Brown, 3, King Henry's Walk, Mildmay Park, clerk; A. E. Dayes, 5, Shephers Place, Kennington, clerk; A. W. Boon, 22, Cold Harbour Lane, Camberwell, clerk; B. H. Bourne, 50, Harleyford Road, Kennington, clerk; A. H. Skan, 2, Ladywell Park, Lewisham. The number of directors is not to be less than three, nor more than seven. The subscribers are to appoint the first. Qualification 100 shares; remuneration £100 each per annum (£50 extra for the chairman), and a share in the profits. Registered by Jenkins, Baker & Co., 134, Fenchurch Street, E.C.

Electric Sign and General Advertising Company, Limited (45,610).—This company was registered on October 12th with a capital of £5,000 in £1 shares, to acquire and carry on the business of electrical and other advertising apparatus manufacturers carried on by G. C. Fricker and A. W. Poulton, at 46, Queen Victoria Street, E.C., and to adopt a certain agreement. The subscribers (with one share each) are:—A. W. Poulton, Kenmore, Streatham, gentleman; G. C. Fricker, 46, Queen Victoria Street, E.C., electrical engineer; F. Miller, St. Margaret's, Greencroft Gardens, N.W., gentleman; G. S. Warmington, 30, Budge Row, E.C., solicitor; D. J. Edmonds, 40, Weston Park, Crouch End, N., solicitor; W. H. E. Godolphin, 22, Montrave Road, Penge, clerk; F. Huntley, Trinity Road, Tulse Hill, solicitor. The number of directors is not to be less than two nor more than five; the first are A. W. Poulton and G. C. Fricker; qualification, £500; remuneration as the company may decide. Registered by G. S. Warmington & Co., 30, Budge Row, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Consolidated Telephone and Manufacturing Company, Limited (15,212).—This company's annual return was filed on September 10th. The capital is £234,938, in 224,850 10s. ordinary shares, 47,363 £6 per cent. £1 preference, and 75,150 £1 ordinary shares, and all of the first class have been taken up, the full amount called, and £112,425 paid.

Newmarket Electric Light Company, Limited (44,450).—The registered address of this concern is situate at High Street, Newmarket St. Mary, Suffolk.

London and Lancashire Electric and General Engineering Company, Limited (38,281).—The annual return of this concern was filed recently, when 1,987 shares were taken up out of a capital of £20,000, in £5 shares. 1,000 have been issued as fully paid, and £2 per share called on the rest. £1,864 has been paid, leaving £112 in arrears.

Column Printing Telegraph Syndicate, Limited (29,493).—This company's annual return was filed on September 3rd. 289 shares have been taken up out of a capital of £25,000, in £50 shares; 100 have been considered as paid, and £8,900 has been paid on the others.

CITY NOTES.

Brazilian Submarine Telegraph Company, Limited. The accounts of this company show a profit sufficient to enable the directors to recommend a final dividend of 3s. per share, making, with previous distributions, a total dividend of 6 per cent. for the year ended June 30th, 1895, and also the payment of a bonus of 2s. per share, both free of income-tax, which together will amount to £32,500, leaving a balance of £34,410, of which amount £30,000 has been placed to the reserve fund, and £4,410 carried forward. For the purpose of paying the above dividend and bonus on the 31st inst., the register of transfers will be closed from October 22nd to 30th, both days inclusive.

Salt Lake and Ogden Gas and Electric Light Company, Limited.—Letters of allotment for the 5 per cent. preference shares were posted on Tuesday evening.

St. James's and Pall Mall Electric Light Company, Limited.—The sale of electricity for the quarter ending September 29th, 1895, representing the supply at 6d. per unit, amounted to £7,402, as against £6,935 at the same rate for the corresponding period of 1894.

West India and Panama Telegraph Company, Limited.—The directors have decided to recommend for the six months ending June 30th a dividend of 6s. per share on the first and second preference, and of 1s. 3d. per share on the ordinary shares.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 13th, 1895, amounted to £916; week ending October 14th, 1894, £920; decrease, £4; total receipts for half-year, 1895, £12,774; corresponding period, 1894, £12,931; decrease, £157.

The Liverpool Overhead Railway Company. The receipts of this railway for the week ending October 13th, 1895, amounted to £1,118; corresponding week last year, £906; increase, £212.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 11th, 1895, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,248.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation, Oct. 9th.	Closing Quotation Oct. 16th.	Business done during week ended Oct. 16th, 1895. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	...	4 %	4 %	102 —105	102 —105	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 15s.	£2 11s.	£2 2s.	47 — 49	45 — 47 xd	46½	...
2,993,560£	Do. do. 6 % Pref.	Stock	£5 10s.	£5 2s.	£4 4s.	87½— 88½	86 — 87 xd	87⅜	87
2,993,560£	Do. do. Defd.	Stock	...	...	...	7⅜— 8¼	7½— 7¾	7⅝	7 5/16
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	6½% §	...	14 — 14½	14 — 14½	14⅜	14 3/16
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	...	111 —115	111 —115	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	10%‖ §	... §	2½%	3½— 4	3½— 4	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	164 —168 xd	164 — 168	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	2 % §	1½%	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	13 — 14	13 — 14	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	20½— 21½	20½— 21½	20⅞	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	4 — 5	4 — 5 xd	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	9¾— 10½	9¾— 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	...	4½%	104 —107	104 —107	...	...
60,710	Direct United States Cable, Ltd.	20	3½% §	2⅝% §	2 %	8¾— 9¼	8¾— 9¼xd	...	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½% §	6½%	17½— 17⅝	17⅛— 17⅜xd	17½	17⅛
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 % §	6 %	18 — 18½	18 — 18½xd	...	...
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5 %	107 —110	107 —110	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	129 —132	129 —132	131⅜	130¼
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	18 — 18½	18 — 18½xd	18½	18 1/16
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	103 —107	103 —107	104⅜	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	104 —107	104 —107	104⅜	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	128 —131	128 —131	130½	129½
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	103 —107	103 —107	...	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	104 —107	104 —107	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	108 —111	108 —111	108½	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	114 —117 %	114 —117%	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅞% §	4⅝% §	4½%	10⅛— 10⅜	10⅛— 10⅜	10⅜	10⅛
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	6 %	17 — 17¼	17 — 17¼	17 3/16	17
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅘% §	8⅘% §	8⅘%	21⅜— 22¼	21⅜— 22½	21⅝	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	103 —106	103 —106	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	50 — 53	50 — 53	51¼	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6 %	106 —110	106 —110	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	...	...	...	2 — 2⅛	2 — 2⅛	2⅛	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 % §	5 %	6⅛— 6⅜	6⅛— 6⅜	6 5/16	6⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	16 — 18	16 — 18	17⅜	16⅜
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	15 — 16	15 — 16	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6¼— 6½	6¼— 6⅝	6 7/16	6 5/16
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	106 —108	106 —108	107	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	4⅛%	1/16— 1/8	1/16— 1/8	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	109 —112	109 —112	...	...
11,839	Reuter's Ltd.	8	5 %	0 %	*nil*	5 — 6	5½— 6½	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	128 —133	127 —132	129½	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	3¼— 3½	3¼— 3½	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	93 — 98	92 — 97	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	..	...	*nil*	5½— 6½	5½— 6½	...	...
238,300£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	104 —107	...	...
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	1½— 2	1½— 2	...	...
150,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	...	100 —105	100 —105	..	...
64,248	Western and Brazilian Teleg., Ltd.	15	2½%	2½%	3 %	10 — 10½	10¼— 10⅜	10½	10
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6½— 7	6⅜— 7	6½	...
33,129	Do. do. do. Def. Ord.	7½	...	...	1 %	3⅜— 4¼	3⅜— 4¼	...	...
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	6 %	104 —108	103 —107	105¼	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	6 %	104 —108	103 —107	..	..
88,321	West India and Panama Teleg., Ltd.	10	1/16	1/16	1/16	¾— 1	¾— 1	1 1/16	1 1/16
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	10½— 10⅝	10½— 10⅝	10⅝	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	8½— 9½	8½— 9½	9⅜	9
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	111 —114	111 —114	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7 %	113 —118	113 —118.	....	....
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	100 —103	100 —103	....	....

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	5 %	4½%	4½%	5½— 5⅝	5½— 5⅝	...	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	...	...	...	6¾— 7¼	6¾— 7¼	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	...	116—119	116 — 119	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	5 %	13½— 14½	13 — 14	13⅜	13
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	14½— 15½	15 — 16	15½	15½
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	133 —137	133 —137	...	...
22,475	County of London and Brush Prov. Elec. Ligtg., Ltd., Ord. 1—22,475	10	...	...	...	8½— 9½	8½— 9½	...	...
10,000	Do. do. do. 6% Pref., £6 pd., 40,001—50,000	10	...	...	...	8⅞— 9½	8⅞— 9½	...	...
50,000	†Liverpool Electric Supply, all paid	5	5 %	5 %	5½%	7⅞— 8⅛	7⅞— 8⅛	...	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2 %	2½%	3 %	11½ — 12	11½— 12	11 15/16	...
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	117 —119	117 —119	118½	117
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	1 %	8½— 9½	8½— 9¼	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	7½%	4½%	6½%	8½— 8⅝	8½— 8⅝	8½	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 10	9½	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	3½%	4 %	5 %	8½— 9	8½— 9	8⅞	...

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1892.	1893.	1894.	Closing Quotation, Oct. 9th.	Closing Quotation, Oct. 16th.	Business done during week ended Oct. 16th, 1895. Highest.	Lowest.
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	6 % §	6 % §	...	1½— 1⅝	1½— 1⅝	1 13/16	1 7/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	6 % §	...	2 — 2¼	2 — 2¼	2 3/16	2 1/16
125,000£	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	4½%	...	112 —115	111 —114	114	112⅝
630,000£	City and South London Railway	Stock	⅝%	⅝%	1¼%	38 — 40	38 — 40	...	...
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 % §	7 % §	...	1½— 2	1½— 2	1 1/16	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	...	...	5 %	1¾— 2¼	1¾— 2¼	...	...
100,000	Do. do. do. 4½% Deb. Stock Red....	Stock	...	...	4½%	104 —107	104 —107	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	*nil*	⅝— ⅞	⅝— ⅞	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	7 %	2 — 2½	2 — 2¼xd	2¼	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	¾— 1	¾ — 1	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	⅞— 1⅛	⅞ — 1⅛	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	...	¼— ⅜	¼— ⅜	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	*nil*	...	6½— 7½	6½— 7½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	6 %	13½— 14	14 — 14½	14⅜	13⅜
3,000	Do. do. do. 7% Pref.	10	...	...	...	15½— 16½	15½ — 16½xd	16	15 11/16
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	...	105 —108	106 —109	106½	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	10 %	19 — 21	19 — 20	19¾	19
200,000£	Do. do. do. 4½ % Deb., 1896	100	4½%	4½%	4½%	100 —102	101 —102xd	.	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	1 %	1½%	11⅞— 12⅛	11¾ - 11⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	...	5 %	5 %	15 — 15½	15 — 15½		...
37,350	Telegraph Constn. and Maintce., Ltd.	12	15 %	20 %	20 %	43 — 45	43 — 45	44½	...
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	.	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000, £4 paid ...	10	...	...	...	4⅜— 4⅞	4⅜ — 4⅞	4⅞	4⅜

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 6—6½.

Electric Construction Corporation, 6 % Debentures, 95—100.

House-to-House Company (£5 paid), 4½—4⅝.

Do. do. 7 % Preference, of £5, 8—8¼.

Do. do. 4½% Debentures of £100, 110—112.

Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 8—8½; 1st Preference Cumulative 6 %, £5 (fully paid), 7—7½.

Liverpool Electric Supply, £5 (fully paid), 7⅞—8¼.

London Electric Supply Corporation, £5 Ordinary, ⅜—½.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 6⅞—7¼.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

ALTERNATE CURRENT MOTORS.

By W. G. RHODES, M.Sc.,
City and Guilds of London Institute. Central Technical College.

(*Continued from page* 310.)

Non-Synchronous Motors.—The chief disadvantage of the synchronous motor is, as we have seen, its inability to start without first being mechanically run up to the speed at which it synchronises with the current from the generator. This disadvantage precluded the use of alternate currents for the transmission of power for motive purposes, until Tesla and others devised motors in which a starting torque is produced, not by means of a single alternating current, but by sending two or more currents in different phases through the coils on the stationary part, or the *stator*, as Professor S. P. Thompson terms it; the rotating part, or the *rotor*, consists of short-circuited coils on an iron core, and the torque is produced by the action of the currents in the stator on the induced currents in the rotor.

We do not propose to give here a history of the development of these motors. Our aim is to consider the motors as they exist at present, and to give a simple, and at the same time an accurate, treatment of their theory. Should any reader wish to trace the evolution of these machines, we refer him to Professor S. P. Thompson's treatise on "Polyphase Currents."

Every electrical engineer is well acquainted with an alternate current transformer, and understands perfectly how it is that for any power given to the primary circuit there is an equivalent—minus the small losses due to eddy currents, hysteresis, and heating—given out by the secondary. The alternating current in the primary creates an alternating field which induces an alternating current in the secondary; the secondary circuit is closed through an external circuit, consisting of lamps, say, and the power is spent in producing light.

The self-starting motors mentioned above and ordinary transformers are identical, as far as their electrical properties are concerned. The primary circuit (or stator) is energised by alternating currents from a generator, currents are induced in the secondary circuit (or rotor), which is short-circuited; the rotor is mounted on an axle and is free to rotate; and the power is spent in producing rotation.

We see, therefore, that these motors—induction motors we will call them—are simply transformers with short-circuited secondaries mounted in such a way as to be free to rotate.

We have purposely introduced the subject by stating the properties of transformers, because, by regarding an induction motor as a transformer with movable secondary, we obtain a much clearer idea of its principles, and find that we are only dealing with an old problem in a new form.

A simple example of an induction motor is given by what is known as Arago's disc. A disc of copper is mounted on a pivot; directly above the disc and parallel to it, is a bar magnet also on a pivot. If the magnet is rapidly rotated the copper disc starts rotating, and the two tend to rotate synchronously in the same direction. If the disc were first rotated, the magnet would begin to rotate. The theory of the experiments is as follows:—The rotating magnet causes lines of force to cut elementary sectors of the copper disc, inducing currents whose directions are more or less radial; the interaction of the induced currents and the field of force due to the magnet produces the rotation. The explanation of the inverse experiment is similar.

In a practical form of induction motor, the stator corresponds to the magnet and the rotor to the disc in Arago's experiment. The stator does not rotate, but it is energised by currents in such a way as to cause its *polarity* to rotate. The *lines of induction* due to the stator have a rotary motion; they cut the conductors on the rotor, and the action between

the currents thereby induced and the rotating induction lines, causes the rotor to revolve.

On account of the rotating property of the magnetism of the stator, some writers call these motors *rotary field motors*. We must not allow ourselves to be misled by this term into supposing that the stator constitutes the field magnets and the rotor the armature. According to the strict definition, the *field magnet* of an electro-magnetic machine is that part, whether moving or stationary, in which the induction varies the least, and the *armature* is that part in which the induction varies the most. In an induction motor, then, the stator corresponds to the armature and the rotor to the field.

When we wish to emphasise the rotary property of the magnetism of the stator we shall call the machines *rotary magnetic field motors*.

We have now to see how it is possible for the polarity of the stator to rotate while the stator itself remains stationary.

The Production of a Rotary Magnetic Field.—Suppose we have an anchor-ring of laminated soft iron, wound as in fig. 14, so that the coils, $a\ a'$, are traversed by an alternating

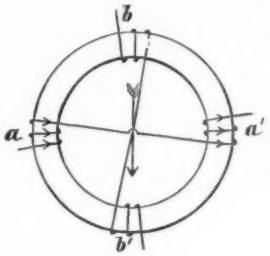


Fig. 14.

current, and the coils, $b\ b'$, traversed by a second alternating current of the same amplitude and period, but lagging behind that in $a\ a'$ by a quarter of a period. When the current in the coils, $a\ a'$, is a maximum, that in $b\ b'$ is zero, so that if the direction of the current in $a\ a'$ at that instant is represented by the arrow-heads, the ring will be magnetised in the direction, $b\ b'$, the south seeking (S) pole being at b', and the north seeking (N) pole at b. A quarter of a period later there will be no current in the coils, $a\ a'$, and that in the coils, $b\ b'$, will have attained its maximum value, so that the S pole of the ring will now be at a, and the N pole at a'. In another quarter of a period the S pole will be at b and the N pole at b', and so on. We see, therefore, that the anchor-ring energised by two equal alternate currents, differing in phase by a quarter of a period, will have its magnetism rotating at such a speed that its magnetic axis will have turned through 180° in half the periodic time of either current.

If we place inside this anchor-ring a rotor with short-circuited conductors, which are always at right angles to the direction of the magnetic field, induced currents will be set up, and there will be an action between the induced currents and the rotating magnetic field, which will cause the rotor to revolve. The moment of the couple tending to make the rotor revolve, will at any instant be proportional to the magnitudes of the induced currents, that is, to the relative angular velocity of the rotor and the magnetic field.

It is evident, therefore, that the torque will be a maximum when the rotor is at rest, and will diminish as the speed increases, vanishing only when the rotor is in synchronism with the revolving magnetic field.

A motor, such as is described above, in which the stator is magnetised by two currents differing in phase by a quarter of a period, is called a two-phase, or di-phase, induction motor.

Next, suppose our anchor ring to be wound with three coils, A, B, C, placed 120° apart, as in fig. 15A, and traversed by currents of equal period and amplitude, but differing in phase by 120°, so that if current in $A = i \sin pt$, then current in $B = i \sin\left(pt + \frac{2\pi}{3}\right)$, and current in $C = i \sin\left(pt + \frac{4\pi}{3}\right)$

Consider the instant at which the current in A is zero and increasing positively, the current in B is then $+\frac{\sqrt{3}}{2} i$ and diminishing, and that in C is $-\frac{\sqrt{3}}{2} i$ and increasing, so that these currents conspire to make an S pole at A and an N pole at the diametrically opposite point. The direction of the magnetic field is, therefore, given by the arrow in fig. 15B, the arrow head pointing towards the S pole.

Considering similarly the subsequent instants at which the currents in the coils B and C are zero, the corresponding directions of the magnetic field will be represented respectively in figs. 15C and 15D, the arrow head always pointing towards the S pole.

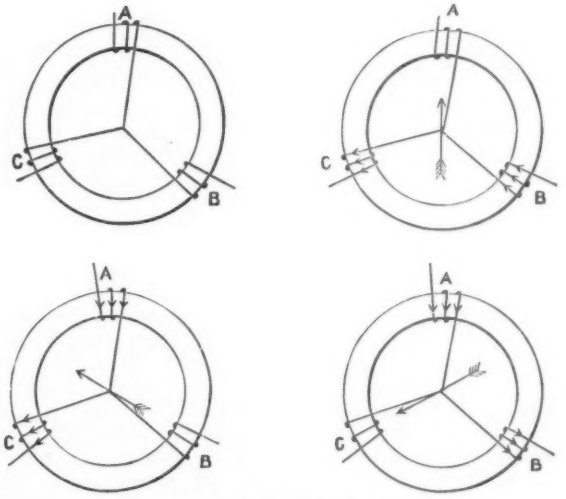
Thus, in a third of the periodic time of the currents the magnetic field has turned through an angle of 120°, so that three currents of equal periodic time and amplitude, but differing in phase by 120° produce a magnetic field which rotates with a uniform angular velocity $\frac{2\pi}{\tau}$, where τ is the periodic time of any one of the currents.

If a rotor such as is described above be placed coaxially with the anchor-ring, a torque will be produced and mechanical power will be developed.

A motor, whose stator is magnetised by three currents differing in phase by 120°, is called a three-phase or tri-phase induction motor.

It will now be seen that n-phase induction motors—where n is any positive integer—might be built, but we shall confine ourselves to the consideration of di-phase and tri-phase motors as they are the only two kinds of polyphase motors used in practice.

We have hitherto only shown that the magnetic fields in di-phase and tri-phase induction motors revolve with uniform



Figs. 15A, 15B, 15C, 15D.

velocities dependent on the periodic time of the currents. We have now to investigate the magnitude of these magnetic fields, and to see what variations, if any, they are subjected to.

The question of the magnitude of the magnetic field is one about which there seems to be considerable misapprehension, we will, therefore, give an analytical, and also a graphical, treatment, explaining carefully each step as we proceed. For the analytical method we shall require a well known theorem, which we proceed to state.

Suppose any magnetic circuit to include lengths, l_1, l_2, l_3, &c., of substances whose permeabilities are μ_1, μ_2, μ_3, &c., and cross sections A_1 A_2, A_3, &c., and suppose further that a current of i ampères is flowing through n turns of wire surrounding the circuit, then the total induction, F, round the circuit is given by

$$F\left(\frac{l_1}{\mu_1 A_1} + \frac{l_2}{\mu_2 A_2} + \frac{l_3}{\mu_3 A_3} + \&c.\right) = \frac{4}{10} \pi n i.$$

It is scarcely necessary to prove this result, as it is a fundamental equation in the design of the field magnets of a dynamo, we will, therefore, take it for granted that our readers are acquainted with it.

In all induction motors the magnetic circuit includes one portion in the stator, a second across the air gaps (between stator and rotor), and a third through the rotor, so that the total induction, F, at any instant, is given by

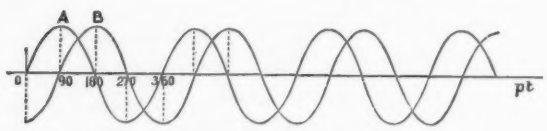
$$F\left(\frac{l_1}{\mu_1 A_1} + \frac{2 l_2}{A_2} + \frac{l_3}{\mu_3 A_3}\right) = \frac{4}{10}\pi n i,$$

l_1 being the mean length of a line of induction through the stator, l_2, the normal distance (air space) between rotor and stator, and l_3 the mean length of the induction lines through the rotor A_1, A_2, A_3, being the respective mean sections normal to the lines of induction, and $n i$ being the instantaneous value of the ampère turns round the magnetic circuit.

We see, therefore, that the total induction at any instant is proportional to the corresponding instantaneous value of the ampère turns.

Now let us refer to fig. 14. When the current in the coils $a\ a'$ is a maximum, that in $b\ b'$ is zero, and the number of ampère turns tending to produce a magnetic field is $n\ i$, where n is the number of turns in each section of the windings, and i is the maximum value of the energising current. After a lapse of one-eighth of a period, the values of the currents in the coils, $a\ a'$, $b\ b'$, will each equal $\frac{i}{\sqrt{2}}$, and the number of ampère turns will now be $2\frac{n i}{\sqrt{2}}$ or $\sqrt{2}\, n i$. After another eighth of a period the number of ampère turns is again $n i$, and so on. Thus the maximum number of ampère turns is $\sqrt{2}\, n i$, and the minimum number $n\ i$. Supposing now that the iron of the stator is far from saturation, it follows that the induction or the strength of the magnetic field, due to the ampère turns on the stator, varies between limits which are proportional to 1 and $\sqrt{2}$, or to 1 and 1·414, that is the induction will vary by about 41 per cent.

Graphical Method.—This variation of the induction may be represented graphically as follows :—Two alternate currents differing by a quarter of a period and of equal amplitude are represented in fig. 16. The current represented by the

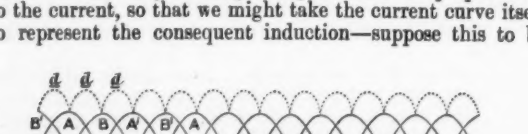


Two currents differing in phase by a quarter of a period.

FIG. 16.

curve, A, is a quarter of a period in advance of that represented by B.

We have now to give a graphical representation of the induction produced by these currents. Referring to fig. 14, we see that the current in the coils, $a\ a'$, always *assists* that in $b\ b'$ in producing a field of force—that is the effects of the currents are algebraically added. Now the effect of either current in producing a magnetic field is proportional to the current, so that we might take the current curve itself to represent the consequent induction—suppose this to be



Induction produced by two currents differing in phase by a quarter of a period when coils are wound as in fig. 14.

FIG. 17.

done for each of the four coils, $a\ a'$, $b\ b'$. Paying particular attention to the way in which these coils are wound in fig. 14, we see that if the currents in $a\ b$ tend to make the induction clockwise, then those in $a'\ b'$ produce a counter-clockwise induction ; the separate inductions are therefore represented in fig. 17 by the curves, B', A, B, A', &c., where the curves, B', A', are the negative portions of the curves, B, A, in fig. 16. Our justification for thus rectifying the curves of fig. 16 lies in the way in which the coils are wound round the stator. Some writers object to the curves being rectified in this way, since there is no device for rectifying the currents. We must remember, however, that fig. 17 is not a representation of the currents, but of the induction, and the phase of the induction does not depend only on the value of the current, but also on the way in which the coils on the stator are wound. The *currents* in the coils of fig. 14 are *two-phased*, but the *induction is four-phased*, for the induction produced by a' differs by 180° from that produced by a.

To obtain the resultant induction we must add the curves, B', A, B, and A' together. We thus obtain the dotted curves, d, as a graphical representation of the magnitude of the induction at any time. When the current, A, is zero, B is a maximum. Let the induction then be represented by unity: 45° later its value is

$$\sin 45° + \sin 45°,$$

or

$$\sqrt{2},$$

and so on. We again obtain, therefore, that the induction varies between limits proportional to 1 and 1·414, that is, there is a variation of about 41 per cent. of its minimum value, or 20·5 per cent. of its mean value. We have considered the induction to be due simply to the currents round the stator. There is, of course, the modifying effect of the rotor currents to be taken into account. We leave this for the present and pass on to consider the induction produced in a tri-phase motor.

(*To be continued.*)

LAMP MAKING IN ENGLAND.

SOME time ago we showed, in the course of an article on incandescent lamps, that the free trade in lamp making had really resulted in them being made in more than one place in this country. Electrical men will doubtless remember that works were set up in 1887 at Gateshead-on-Tyne for the manufacture, mainly, of large incandescent lamps, and were continued till about 1891, when, on the application of the Edison-Swan Company, an injunction effectually stopped operations. The works thus closed by law were those of the Sunbeam Lamp Company, who at the time were becoming well known in connection with the large lamp that bore their name. To the minds of many readers the Sunbeam lamp will rather suggest the larger type of lamp than the smaller one. They were fairly common some four or five years ago in illuminating the exteriors of offices, warehouses, &c., but they naturally disappeared when the injunction was granted against the Sunbeam Company.

Since the injunction expired the Sunbeam Company have been making lamps of all candle-power. The largest made as a regular trade production are of 2,000 C.P., though some have been made of 3,000 C.P. In spite of the fact that the consumption of current for these high candle-power lamps is considerable, compared with arcs, they are apparently much employed under certain conditions. There is no doubt that large incandescent lamps are in many cases preferable to arc lamps for interior lighting, and can very often replace small incandescents with economy.

Perhaps the most interesting operation in the making of incandescent lamps is that which is usually kept a manufacturer's secret; may be, it is interesting for that reason.

The lamp bulbs, though not actually made on the works, are manufactured in England. In fixing the filaments into the bulbs, which necessitates the art of the glass blower, men and boys only are employed. This is, of course, near the end of the series of operations. We are unable to say much about the construction of the filament; its treatment, however, in the Sunbeam works is of the most careful description. The head of the treating department personally inspects each filament, and any carbon not up to the requisite standard is immediately destroyed. The treatment of the carbon consists in making it of equal resistance throughout, the process scarcely differing from the well-known

flashing operation employed generally in lamp making. The filament is then passed on to the depositing room, where the carbon is fastened on the platinum stems, which have been already made in a separate department, and glassed ready for the carbons. The filaments, it may be mentioned here, are fired in ordinary coke furnaces, no gas or vapour of any kind being used.

The lamps are partially exhausted by mechanical means, the final operations being done by the mercury pump, which is a modification of Sprengel. It is claimed that the vacuum obtained is of the highest character. Each lamp is tested photometrically, a form of Bunsen photometer being employed; the original standard is the Methven, a set of incandescent lamps being standardised periodically from this and used against the new lamps. Besides the C.P. of the lamp being tested, the efficiency is noted as well as the voltage. Each lamp is marked, those not up to standard being put aside to be eventually sold as odd lamps. After testing, the lamps are conveyed to the collaring room, where they are capped. The special feature in the collar which is employed is, that the plaster is prevented from touching the glass; a kind of spring clamps the top of the lamp, which is specially indented to receive the collar. It is claimed that by using this form of collar a current of air can pass round the lamp, thereby keeping it cool, and preventing the cracking of the plaster and the subsequent loosening of the collar which is not unknown in some lamps. These special collars are not fitted to all the lamps, some being made with loops or other terminals, according to the wishes of the customer. After the collaring operations, the lamps are taken to the mounting room; they are afterwards tested for vacuum by means of an induction coil, and the connections carefully examined. After being washed, and the C.P. and voltage etched, they are put into stock. As an instance of the care that is taken in ensuring the quality of the lamps, it may be mentioned that before being sent out they pass again through the tests which were made before being stocked.

The electric generating plant consists of four Clarke-Chapman direct current dynamos, driven by Crossley gas engines, no alternator being employed at present.

In the small lamps, 8 and 16 C.P., the company guarantee as low a consumption as 3 to 3½ watts per candle, the larger lamps, 50 C.P., &c., having a consumption of 2 watts per candle. Two hundred volt lamps have been made, and we understand that the company is ready to meet any demand that may arise for these and higher voltages.

The Sunbeam Lamp Company is a limited one, the managing director of the company being Mr. Edmundson, who, in the old days, was with the Swan Company; Capt. A. H. Chapman, J.P., is the chairman of the company, and the works are at Gateshead, the London House being at 50, Fenchurch Street.

THE INSTITUTE'S NEXT PRESIDENT.

A CORRESPONDENT of our contemporary, *Engineering*, says it is an open secret that there is a probability of the Council of the Institution of Electrical Engineers recommending Sir David Salomons for election to the Presidential Chair, and urges the importance of the matter being reconsidered, on the ground that Sir David is not an electrical engineer, and, therefore, as President, could not represent the society as it should be represented, by one at the "head of the profession." We do not know what amount of truth there may be in the rumour to which the correspondent refers, but we doubt whether the drawing of invidious comparisons will facilitate the proceedings of the Council in the matter. The membership of the Institute is more varied than that of any similar society, and amongst the officers it is inevitable that there should be some who are not strictly electrical engineers, but whose interests in the science or the industry fully entitle them to a place in the council, or even amongst the vice-presidents. The president is usually, although not invariably, chosen in rotation from the ranks of the vice-presidents, and any change in a custom of this sort is liable to be regarded as a reflection upon the member passed over. Such a consideration is likely to weigh with those who have to take the first step. We cannot conceive of any instance in which the rotation system might be disregarded with less reflection upon the member passed over. Sir David's personal suitability for the office is not in question; his knowledge of electrical engineering is not in question. A member's capacity for the presidential chair is not ascertained until some time after he has been placed in it, and Sir David's election would probably give the Society a president who would represent it worthily, and conduct its affairs capably; but his election, nevertheless, would show that electrical engineers do not take their profession quite seriously, for Sir David's work in the science is that of a *dilettante*, and his most prominent position in the industry is that of chairman of an electric light company. We do not think that either alone, or both combined, would justify his selection for office, so long as men were available who had made their mark, and acquired their position, in the exercise of their profession.

The membership of the Institution should be as wide as possible, and the more varied the experience amongst the officers the better; but the position of president should be filled by one who has seriously undertaken electrical work as a profession.

THE RESPIRABILITY OF AIR IN WHICH A CANDLE-FLAME HAS BURNT UNTIL IT IS EXTINGUISHED.*

By FRANK CLOWES, D.Sc.

At the last meeting of the British Association the author stated the composition of artificial mixtures of nitrogen and of carbon dioxide with air, which were just able to extinguish various flames. It was found that the flames of ordinary candles and lamps were extinguished by mixtures which contained on an average about 16·5 per cent. of oxygen and 83·5 per cent. of the extinctive gases. A flame of coal gas, however, required for its extinction a mixture still poorer in oxygen, and containing 11·3 per cent. of oxygen and 88·7 per cent. of the extinctive gases. These results have since been confirmed by a different method.

The method consisted in allowing the flames to burn in air inclosed over mercury until they were extinguished; the remaining extinctive atmosphere was then subjected to analysis, when its composition was found to be practically identical with that previously obtained from the artificial mixtures. An analysis of air expired from the lungs proved that it was also of the same composition as that which extinguished the flame of an ordinary candle or lamp.

The average percentage composition of expired air and of air which extinguishes a candle-flame is as follows:—Oxygen, 15·9; nitrogen, 80·4; carbon dioxide, 3·7.

Now an atmosphere of this composition is undoubtedly respirable. Physiologists state that air may be breathed until its oxygen is reduced to 10 per cent. The maximum amount of carbon dioxide which may be present is open to question, but it is undoubtedly considerably higher than 3 per cent. Dr. Haldane maintains that the above atmosphere is not only respirable, but could be breathed by a healthy person without inconvenience of any kind; he further states that no permanent injury would result from breathing such an atmosphere for some time.

The conclusion to be drawn from these facts is, that an atmosphere must not be considered to be dangerous and irrespirable because the flame of an ordinary candle or oil-lamp is extinguished by it. The view is very generally advanced that a man must on no account venture into air which extinguishes the flame of a candle or of a bundle of shavings. It will be seen that this precaution may deter one from entering an atmosphere which is perfectly safe and respirable, and from doing duty of a humane or necessary character.

An atmosphere which extinguishes a coal-gas flame, however, appears to approach closely to the limit of respirability, as far as the proportion of oxygen which it contains is concerned. Hence the coal-gas flame appears to be a more trustworthy indicator of respirability than the flame of a candle or oil-lamp.

Undoubtedly the candle and lamp flames should be discarded as absolute tests of the respirability of air.

NEW PATENTS—1895.

18,200. "Improvements in connection with arc lamps, more particularly adapted for electric search lights." F. M. Lewis. Dated September 30th.

18,226. "Improvements in secondary batteries." C. Fisher and L. Bertram. Dated September 30th.

* Read before the British Association (Section B), Ipswich Meeting, 1895.

18,236. "Improvements in or connected with electric burglar and other alarms." T. A. Clarke. Dated September 30th.

18,305. "Improvements in means of supporting and insulating electric conductors within culverts or like conduits." R. E. B. Crompton. Dated October 1st.

18,318. "Improvements in hanger boards for electric arc lamps." T. E. Adams. Dated October 1st. (*Complete.*)

18,342. "Improvements in lamp or candle shades and reflectors." D Owen. Dated October 1st.

18,369. "Improvements in electric locomotives." J. E. Amen. Dated October 1st.

18,376. "Improvements in holders for incandescent electric lamps." W. M. Habt and W. H. Whiteside. Dated October 2nd.

18,385. "Duplex telephony." A. M. Rosebrugh. Dated October 2nd.

18,406. "Mode of producing contemporary hypochlorites, chlorates, hydrochloric acid, caustic soda, and hydrogen, from the sea water by means of the electricity." G. B. Baldo. Dated October 2nd. (*Complete.*)

18,420. "Improvements in electrical apparatus for railway signalling." A. H. S. Daniell. Dated October 2nd.

18,440. "Improvements in arc lamps." G. Hill. Dated October 3rd.

18,453. "Electric cable casings." G. H. Nisbett. Dated October 3rd.

18,483. "Improvements in electric glow lamps." G. Davis. Dated October 3rd.

18,484. "Improvements in safety devices or fuses for electric circuits." A. M. Billington. Dated October 3rd.

18,487. "Improvements in the electrolytic manufacture of ferro-manganese, ferro-chrome, ferro-aluminium, ferro-nickel, and other alloys having an iron base." J. Heibling. Dated October 3rd.

18,505. "A new or improved method of and apparatus for electrically transmitting indications or changes of position of a body." H. O. F. Bindemann. Dated October 3rd. (*Complete.*)

18,531. "Improvements in recording instruments for telegraphic and other purposes." W. Thomson (Baron Kelvin). Dated October 4th.

18,557. "Improvements in galvanic and storage batteries." J. B. Torres. Dated October 4th.

18,583. "Improvements in means for making electric connection between lengths of rail and the like." H. Edmunds. Dated October 4th.

18,584. "Improvements in or connected with electrical conductors." H. Edmunds. Dated October 4th.

18,586. "An improvement in secondary batteries or accumulators." R. Pearson. Dated October 4th.

18,588. "Improvements in fusible cut-out or safety devices for electric conductors." G. W. Partridge and A. F. Berry. Dated October 4th.

18,602. "Improvements in electric light and tail lamps for omnibuses, tramcars, and other road vehicles." H. W. Headland. Dated October 5th.

18,622. "Improvements in commutator brushes." N. Greening and N. Greening & Sons, Ltd. Dated October 5th.

18,632. "Improvements in holders for incandescence electric lamps." C. M. Dorman and R. A. Smith. Dated October 5th. (*Complete.*)

18,673. "An automatic speed regulator for electromotors." L. Denayrouze. Dated October 5th.

18,681. "Improvements in alternate current distribution." G. Ferraris and R. Arno. Dated October 5th.

18,682. "Improvements in or applicable to fuel economisers." W. Goodbrand. Dated October 5th.

18,692. "Improvements in the construction of electrodes or plates for secondary batteries." F. E. Everard. Dated October 5th.

18,696. "Improvements in or connected with electric railways or electric transport." J. G. Lorrain. (Communicated by F. C. Esmond, United States.) Dated October 5th.

18,697. "Improvements in or connected with electric railways or electric transport." J. G. Lorrain. (Communicated by F. C. Esmond, United States.) Dated October 5th.

18,698. "Improvements in or connected with electric railways or electric transport." J. G. Lorrain. (Communicated by F. C. Esmond, United States.) Dated October 5th.

18,699. "Improvements in or connected with electric railways or electric transport." J. G. Lorrain. (Communicated by F. C. Esmond, United States.) Dated October 5th.

18,700. "Improvements in or connected with electric railways or electric transport." J. G. Lorrain. (Communicated by F. C. Esmond, United States.) Dated October 5th.

18,701. "Improvements in or connected with electric railways or electric transport." J. G. Lorrain. (Communicated by F. C. Esmond, United States.) Dated October 5th.

ABSTRACTS
OF PUBLISHED SPECIFICATIONS, 1895.

9,132. "Improvements in electrical ceiling and wall connectors." C. M. Dorman and R. A. Smith. Dated May 8th. The inventors secure the flexible conductors to the insulating base by means of a gripping cleat, or cleats, of porcelain or other non-conductor, or consisting partly of metal and partly of a non-conductor attached to the base by means of one or more screws, studs, or bolts in such a manner that the flexible conductors are gripped firmly between the cleat, or cleats, and the base of the connector by tightening up the screws, studs, or bolts. 2 claims.

9,217. "Improvements in electrical cut-outs or safety fuses, switches, and the like." J. B. Verity. Dated May 9th. The inventor employs china, or other insulating bases, of the size and shape to suit the various purposes for which they are intended, and provided with slots or grooves in which the terminals easily slide into position, and in which they are held by a nut or washer fitting over the top of the slot or groove, or in a recess formed thereat. 3 claims.

9,547. "Improvements in and relating to the attachment of an electric lamp to a cap, or the like." H. H. Lake. (Communicated from abroad by A. Rodriguez and E. D. Rockwell, both of America.) Dated May 14th. Consists in the combination with a cap of electric wires permanently applied thereto, and terminating at their rear and forward ends in contact points, adapting the cap to have an electric lamp and body-wires removably connected with it. 2 claims.

9,708. "Improvements in electric heaters or rheostats." J. H. Delany. (Under International Convention.) Dated November 23rd, 1894. Consists in the employment of a base or support of china, porcelain, terra-cotta, tiling, or such like earthy or vitreous material moulded in manufacturing to which the heating or resistance conductors are united or attached by vitreous enamel, making a homogeneous mass under heat. 5 claims.

9,806. "Improvements in diaphragms for use in electrolytical apparatus." R. Comboul. Dated May 17th. Consists in constructing a diaphragm with two or more porous partitions, between which, or each adjacent pair of which, is held a layer of liquid, that may be a solution of salt, the nature of which will not materially impede the electrolytic operation. 3 claims.

10,052. "Improvements in electric railway signals." H. V. Miller and A. C. Miller. Dated May 21st. The object of the invention is to provide a simple, economical, and efficient electric signal for railways, adapted to be used on a moving train, and give warning to the engineer or other train man that the system or section ahead of him is blocked or a switch opened, and that the devices on the same block or system to the rear have operated and are in condition to give a following train the desired signal, or that it has failed to operate, and that he must take all the necessary precautions. 6 claims.

10,587. "Improvements in and relating to electric heaters." C. J. Reed. Dated May 28th. Relates to an electric heater, consisting of a heat-radiating tube having a conducting lining attached to its inner surface, the opposite ends of said conducting lining being connected to current conductors. 6 claims.

10,836. "Improvements in storage batteries." C. Payen. Dated May 31st. Consists in forming the material so that it will be self-supporting and unconfined, and that it can be placed in contact with a suitable conducting plate or a series of conductors, and in one form of the invention the active material can be enclosed in a non-conducting envelope. 15 claims.

10,929. "Improvements in apparatus for electrolysing chloride solutions." E. Hermite, E. J. Paterson and C. F. Cooper. Dated June 1st. Claims:—1. An anode for electrolysing, consisting of a plate carrying a network of platinum wires. 2. An electrolysing cell consisting of a tube of zinc or holding a pair of zinc plates in combination with an anode such as is above referred to, substantially as described.

10,930. "Improvements in apparatus for electrolysing chloride solutions." E. Hermite, E. J. Paterson, and C. F. Cooper. Dated June 1st. Relates to apparatus of a simple and inexpensive kind for electrolysing chloride solutions for the production of disinfecting liquid, and to automatic regulating apparatus for the same. 2 claims.

11,283. "Improvements in and relating to electric high and low-tension fuse heads for use in blasting and other purposes." G. Pettinger. Dated June 8th. Embraces improvements in the construction of those fuse-heads which are inserted in detonators employed for firing gunpowder, dynamite, roburite, and all other explosives used in blasting operations, submarine mining, and like purposes, and an improved explosive compound for use in connection with such fuse heads. 2 claims.

11,375. "A covering for electric wires." F. S. Randall and J. Shallcross. Dated June 11th. Consists in applying the straightened fibres evenly around the wire parallel or longitudinally on the electrical conductor. 1 claim.

11,399. "Arc lamp." S. P. Parmly. Dated June 11th. Claims:—1. The combination of an electric arc lamp with the usual mechanism for controlling the carbons with two carbon electrodes, each consisting of a bar or pencil having a cross sectional area substantially twice the cross sectional area of the ordinary round carbon designed for use with the same current, and substantially, or for the most part, in the form of a bar with a thickness and a width as one to two. 2. An arc lamp provided with carbons of substantially the form and shape shown and described.

11,478. "Improvements in apparatus for the electrolytical separation of precious metals from their ores or other materials containing them." J. Y. Johnson. (Communicated from abroad by L. Pelatan, of Paris, and F. Clerici, of Milan.) Dated June 12th. In this process the minerals, or other materials which contain the precious metals, are pulverised and mixed with a solvent in the same vat in which the metals are separated by means of a current of electricity and retained by a mercury cathode. 4 claims.

11,752. "Electro-deposition of gold and silver." E. Andreoli. Dated June 17th. Consists in using two anodes only in presence of numerous cathodes, and depositing gold and silver from their solution on a large surface of cathodes. 5 claims.